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An Arc Motor. WE give this week cuts and description of the Crocker-Wheeler arc motor that is finding its way into extensive use. The principle of regulation employed is interesting and effective, and the results obtained are reported to be excellent. So much for the care in designing and testing small motors. Large motors have been the subject of great attention, and the results have been admirable in many machines, but it is only recently that the little motors demanded for the proper subdivision of power have been given the study they deserve.

A Glimpse of the Future. THE dinner given the other day in Baltimore, where waiters were superseded by an electric car that darted out of the pantry and served the courses with neatness and dispatch, opens a magnificent vista of future peace. Such a servitor would be a blessed relief from the polyglot importunity of the animate things that we endure to-day. It would demand only its regular wages of current strictly in advance, and would never extend a wheel or switch for tips. Better than all, it is dumb and of unequaled sobriety. Hasten the day when we shall find it in every household.

Fast Telegraphing. THE result of the recent tournament, reported elsewhere in our columns, was rather a surprise to the electrical fraternity. The speed reached was something phenomenal, and, more than this, the average speed was high and much of the sending of remarkably fine quality. Such competitions awaken a great deal of interest in the possibilities of the art of telegraphy, and the preparation for them undoubtedly tends to increase the skill of even those who do not actively participate. One may imagine the wonder with which Morse would have contemplated such an exhibition of skill and marveled at the change that time has wrought.

The Grumbler at it Again. SOME of the residents about the 39th street Edison station are unhappy, and have sought solace in an injunction against the company. They seem to think that the smoke from the station chimney has a peculiar spite against their peace and comfort. It hardly seems possible that they can expect a well established concern to go out of business, or desire Cimmerian darkness in that part of town. A very practical way of securing relief and pelf at the same time would be to devise the "smoke consumer" that everybody who burns coal is seeking. It will be very difficut to secure a permanent injunction against an institution that has rendered itself so necessary to the public.

The Ganz 5 H. P. Motor. THE efficiency curve of this machine is published in this issue, together with some account of the tests. It will be seen that the results obtained are very much the same as those found for the large 25 h. p. machine, except that the efficiency is not so great. It reaches, however, nearly 80 per cent., which, considering the size of the machine, is certainly very satisfactory. The same difficulties were encountered as in the larger motor, sparking on the start and inability to endure much overloading. These objections are not easily overcome, as designers of alternate current motors know only too well, but the case is not hopeless, although perhaps success is not to be attained along the lines followed in this particular machine.

An Interesting Accident. A CURIOUS illustration of the theory of transient currents is that given in another column. A steel bar fell across the terminals of a dynamo, and the immediate result was a violent surface heating that was dissipated almost in a moment when the current ceased. It was not the ordinary heating of a conductor, but a true surface phenomenon. Such an accident is a beautiful exhibition of electrical theory, and fortunately its details fell into the hands of Sir William Thomson, who promptly investigated it. It is sometimes little things of this sort that lead to the most important results, as in the historical case when the almost invisible twitch of a galvanometer needle as the circuit was broken led Faraday to the discovery of induction.

Storage Battery Traction. THOSE interested in rapid transit will regret to notice the recent action of the Brussels Tramway Company in abandoning their storage system. They had a costly experience with it, but much of the expense was due to experiments and improvements made, and it is to be regretted that at this day they should go back to horses. Storage battery traction has come to stay, and in many places, especially abroad, it is the only way of utilizing electricity for city traffic. The reports from London have been of a much more encouraging character, and it is probably only a question of time when the present difficulties will in large measure disappear. The experiments here in New York have met with considerable success, and we hope soon to see the storage battery car part of our regular rapid transit system. In some way or other the horse must go, and the great first cost of cables goes far to offset the lower efficiency of the storage system.

An Electric Drill. WE present some account of a new electric drill in this issue. It is interesting as being simply a reciprocating affair, with no rotating parts, and of very simple construction. There are numerous mining machines, but in general the lighter forms of electric drills have been conspicuous by their absence. There is a good field for such drill, especially in quarries, and if the present device shows a fair degree of efficiency and good wearing qualities, it should be very useful. The distribution of power by steam or compressed air pipes is very inconvenient, specially when a drill has to be moved frequently from place to place, and nearly all the existing power drills are too heavy for ready application to the shifting needs of a quarry. For this particular purpose a drill should be light enough to be handled by a single man, when, if operated by electricity, it could be moved about from place to place almost as readily as a common churn drill, and would take the place of many of those primitive implements. It would be very interesting could we get some efficiency tests of this reciprocating drill, since it would be very difficult to extract any satisfactory idea of the matter from what we know of motors.

Conductivity of Iron and Other Metals. A PAPER of no little interest in this issue discusses the conductivity of various combinations of iron and nickel. The three magnetic metals—iron, nickel, and cobalt—all possess the property of being non-magnetic at high temperatures, and this change is accompanied by profound alterations in the various physical properties of the metals. It seems as though these three metals, like phosphorus, can exist in allotropic forms, and in each case one form has the remarkable property of being magnetic. In the changes that occur with temperature there is almost no property that remains the same, and the electrical conductivity varies in a most remarkable manner as the metal passes through the critical temperature. At that point there is a sudden break and the rate of temperature variation of resistance changes. In some cases more than one such point appears, corresponding always to an alteration of many other properties of the material. The complex nature of the phenomena is very neatly brought out in the paper in question. The whole subject of these physical changes that appear to be so intimately connected with magnetism is one that invites investigation, for it may at last give a clue to the reason why of all the elements only three are to any notable degree magnetic.

Domestic Electric Lighting. WE give in this issue an illustration and description of a dynamo specially designed for use with a gas engine. Such a combination has come into considerable use abroad, but in this country it is not as well known as it deserves to be. A good gas engine, although rather expensive in first cost, is a decidedly economical machine to run, and can be used successfully in private plants where a steam engine would be objectionable. It will give the horse-power hour on 25 feet of gas, and as a 16 c. p. incandescent lamp is practically the equivalent of a five-foot gas burner, we reach the rather remarkable result that a given amount of gas will give more light through the medium of a gas engine and dynamo than it will directly. We may confidently look for development in this direction, so that any one within reach of gas may use electricity for domestic lighting at a cost less than his present gas bill. If fuel gas ever comes into extensive use the gas engine and dynamo will have a further advantage. At present this combination is rather in the background, but there are many cases for which it is admirably adapted. The arc motor and incandescent dynamo is another combination that might be employed very effectively in certain localities, and would require singularly little attention. The efficiency would be very satisfactory and the expense not at all prohibitory.

The Modern View of Electric Currents. THE electrician who knows the theoretical part of his science only as he studied it five or ten years ago, finds his knowledge sadly at fault when he is confronted with the ideas and theories of to-day. Not that any great and radical changes have revolutionized electrical theory in these last few years, but there have been great additions to our knowledge of certain occult phenomena, and theory has advanced correspondingly. We were accustomed to look at the electric current as something that flowed in or along a wire, and too many students grew to think of it almost as a fluid. To those wont to depend slavishly on hydrodynamicanalogies it is rather a rude shock to realize that in very many cases we should pay far less attention to electric disturbances in the conductor than to the extraordinary pulsations of energy that surround it. We must to-day think of a wire carrying a current not as a tube in which a certain mysterious flow is taking place, but as a mere linear nucleus along and around which there is a ceaseless flow of energy capable of producing tremendous effects even far away from the wire. We must think of the conductor not as a thin line of wire, but as the centre of a far-reaching electrodynamic disturbance. To take an extreme case, an alternating current of very short period, capable of producing enormous inductive effects and transferring immense mechanical power, might penetrate the accompanying conductor hardly more than skin deep. What would go on within the wire we might almost neglect—it would be only as we neared and passed its surface that electrical energy would manifest itself. And further, it is a surprise to realize that electro-magnetic induction has suddenly fallen into line with other forms of radiant energy—that the light and warmth of a summer's sun differ from the solar waves of induction that produce magnetic storms only in degree—that a gas flame is just as truly an exhibition of electro-magnetic energy as an electric light. But all this, which may sound so revolutionary, is not new; it has gradually been unfolded during fifteen years of splendid theoretical investigation, and has waited, as the law of gravitation waited more than two centuries ago, for the connecting link of experiment to bind firmly together brilliant hypothesis and recondite mathematics.

NEW BOOKS.

ELECTRICAL ENGINEERING. By W. Slingo and A. Brooker. Longmans, Green & Co., 1890. Pp. 631; 307 illustrations. Price $3.50.

To write a single book covering the whole field of electrical engineering would be so formidable a task that it seems foolhardy to undertake it. The authors of the present work have judiciously confined their attention to that part of the subject which deals with light and power installations, and their treatise, while not without faults, is certainly a useful and commendable addition to the literature of applied electricity. In handling such a subject one must continually be harassed by the fact that the public for which he is writing is composed at present of two widely separated classes—on the one hand, the electrical artisan approaching the study of electricity from the strictly practical side, and demanding a non-mathematical book with full explanations of apparatus and rules of procedure of the cook book variety; on the other hand, the electrical student attacking the applied side of his science and needing a far-reaching co-ordination of theory and practice and not so much simple rules as carefully selected material from which to formulate them. A union of the two elements is impracticable. In the present volume the needs of the former class are specially borne in mind, while at the same time the book will prove useful as a practical discussion for electrical students.

The first chapter is devoted to elementary considerations. It is with regret that we make the acquaintance of the historical stick of sealing wax in the very first paragraph. It would seem as though the time was ripe for the discussion of static charge in a subordinate place and the introduction of the student to the more general and practical case first. In chapter II. the practical units are discussed and Ohm's law is treated pretty effectively. Following this is a chapter devoted to a description of the best known forms of battery, and then in chapter IV. is taken up the measurement of current strength. This necessarily involves some brief discussion of magnetism, and then comes a very clear description of the galvanometer and various well-known ammeters, with excellent cuts and directions for use. Then follows the measurement of resistances, containing much useful information about the practical forms of bridge and the method of using them in making practical tests.

Chapter VI. is devoted to that rather unsatisfactory subject, the measurement of electromotive force. The construction and use of various forms of the commercial voltmeter is well discussed, although if the electrostatic voltmeter was to be introduced at all it should have been in the multicellular form recently brought out.

The discussion of the electro-magnet, which follows, is rather unsatisfactory, the modern idea of magnetism not being clearly brought out. Dr. Hopkinson's beautiful presidential address on magnetism is a model of the modern scientific treatment of the subject, and is specially admirable in that the "magnetic pole" is relegated to the background, as we insinuated that static electricity should be.

Chapters VIII. to XII., inclusive, are devoted to the description and discussion of various kinds of dynamos and motors, the alternating dynamo coming first, as it logically should. This part of the book is necessarily condensed, though it is fairly satisfactory and up to the times, although the proper treatment of the alternating current is very much hindered by the necessity of avoiding mathematics. The chapter on transformers which follows is, aside from the difficulty above mentioned, good, but chapter XIV., on secondary batteries, is perhaps the best in the book. The accumulator is generally very much neglected in books on applied electricity, and it is positively refreshing to find the authors treating the subject in clear detail.

Chapter XV., on arc lamps, contains much interesting matter, and the descriptions are excellent; but the authors have fallen into a very grave theoretical and practical error in their discussion of the so-called "counter electromotive force of the voltaic arc." The very existence of such a thing is problematical, as about all we are justified by the facts in asserting is that the apparent resistance of the arc does not follow Ohm's law. The practical lesson drawn, that an arc cannot be maintained with less than 39 volts, is absurd, as every dynamo-room electrician knows. Chapter XVI. deals with the incandescent lamp and photometry in a much better manner, and in the next and concluding chapter many practical hints are given about switches, fuses, insulation and the like.

On the whole, while it has some faults and omissions, the book is a commendable effort to bring together the fundamental principles and facts of electrical light and power engineering, and it certainly is a volume out of which the elementary student and the intelligent artisan can draw much valuable information.

"THE ELECTRICIAN" ELECTRICAL TRADES DIRECTORY. London, 1890. The Electrician Printing and Publishing Company, pp. 704 + xcix.

This volume is considerably more than its bare title indicates, for it is not only a trades directory, but a collection of valuable and interesting electrical facts besides. The appendix contains brief biographies of well-known electricians, English and otherwise, and the whole book is immensely convenient as a book of reference even for one to whom the directory is useless. The statistical information and tables of practical data are well worth the price of the volume.

L'ANNEE ELECTRIQUE. Delahaye, Paris, 1890, Baudry et Cie. Pp. 381.

This little volume gives a readable résumé of the more important electrical investigations and inventions of the past year, arranged according to subjects. The articles which are abstracted are unfortunately not accompanied by the proper references, though in many cases the abstracts are so extended as to make a reference needless. It is much to be wished that some one would undertake a yearly report of electrical progress as complete and authoritative as the "Jahresbericht für Chemie" is in chemical science. The literature of electricity is growing to be so extensive that a well-edited résumé is almost a necessity.

Lenox Lyceum Electrical Exhibit.

No place in New York presents a more favorable opportunity for the novice to obtain an idea of the wonders of electricity, or the expert to delight himself with a study of its various operations, than Lenox Lyceum. As noticed in our last issue, Mr. Edison has loaned to the New York Exchange for Woman's Work his Paris Exposition exhibit. All over the space of the auditorium are arranged tables upon which are placed various features of the exhibit. These tables are surrounded with railings and placarded with numerous "Don't Handles," so that the instruments—some of which are, of course, of a very delicate nature—will be safe from injury from careless or ignorant hands.

On the walls, below the gallery and near the floor, so as to be convenient for inspection, are ranged photographs of the exhibit as it appeared at the Paris Exposition. These photographs are of interest and use, as they present the objects in a pleasing and concise way, and attract the notice of many to whom the machines themselves would be mere bores.

Immediately adjoining the entrance on the Madison avenue side, stands a wax figure of Benjamin Franklin. It represents the philosopher and scientist as he appeared while making his well-known experiment of the kite and the key. The figure is life-like, and the eyes of the old man are fixed in rapt expectation upon the kite, which flies away up under the beautiful cluster of electric lights that is situate in the centre of the ceiling. An electric wire is attached to the kite, and a current of electricity sends sparks out of the iron key, which is on the kite-string near the philosopher's hand, as it strikes against the jar which rests on a stand just in front of him. The whole idea is unique and interesting. It sends us back from the midst of the advanced state of the science to the time when, an embryo, it awaited its birth into a welcoming world.

In the centre of the floor is a most beautiful pillar. It is about ten feet in diameter at its base, and reaches to near the ceiling. It is covered with diminutive incandescent lamps in a variety of colors. From its apex streamers are stretched to the galleries, and festooned with lamps of the same variegated colors. The effect is beautiful, and claims the first notice of the entering visitor. The switch-boards are inside the pillar, and the switches are operated by a man stationed within. A very pretty effect is produced by turning out all the lights of the pillar and its streamers, thus leaving the pillar simply a dark mass, and then flashing the light from section to section of the spiral coils of lamps that envelop it. By lighting but one section at a time, and turning each off as the succeeding one is turned on, the light flashes around the column with very striking and beautiful effect. It is proposed to arrange at the top of the column additional and larger lamps and inclose them in brilliantly colored glass lamps. With these there will be produced the most beautiful chromatic effects on the ceiling, and a material æsthetic feature be added to the exhibition. The number of lights used in this illumination is 5,000, and as each is of 4 c. p. a total of 20,000 c. p. is employed in this one feature.

The table exhibits are arranged in single groups of subjects. Our space is too limited to permit of any detailed description of the many interesting subjects, and mention can be made in only the most general way. The autographic telegraph is, perhaps, the most interesting in the telegraph exhibit. Specimens of telegrams sent over the wire by this machine are in the possession of the gentleman who presides over this department, who, by the way, is the same gentleman who cared for it at Paris, and these are shown, and in some instances given to visitors.

In the telephone section is shown every stage in the development of the instrument which we now look upon as indispensable to our commercial interests. And right beside this is the great megaphone, with which it is possible to carry on a conversation at a distance of a mile or more, with no other connection between the speakers than that afforded by the atmosphere. Standing in the midst of its smaller brethren, the megaphone appears as a giant among pigmies.

By no means least in interest is the mimeograph, one of Edison's latest inventions. By writing or sketching with a metalic pin on specially prepared paper, manifold copies to the number of 5,000 can be produced from the single original. The principle is, that the ink used in manifolding strikes through the paper only on the lines made by the metallic pen. It is obvious, therefore, that the original sheet may be laid away for an indefinite length of time, and still be used for manifolding.

Mr. Supple, who attended the setting up and arranging of the entire exhibit, both here and in Paris, has had constructed on the floor a miniature electric light station. The small motor is in operation, and the Edison system of underground distribution is shown in practical working, lighting a series of lamps which extends around the inside of the railing in imitation of the incandescent street lighting system. The whole is excellently shown, and the gentlemen in charge are very assiduous in their efforts to make clear to the visitor the entire scheme.

Standing on a table right near the megaphone is an instrument not so well known as most of the others in the Lyceum—a tasimeter. So delicate is the adjustment of this small meter that the heat contained in a single ray of a star can be observed. Of course an instrument so delicate as this cannot possibly be operated in such a place; but it is interesting to see it, and to be told of its wonderful power. A galvanometer also is here, and the little parti-colored wheel is easily set in motion by the contact of the waves of air produced by the voice against the diaphragm of its annunciator.

To commercial men, as well as to scientists, the complete collection of commercial meters, beginning from their origin and ending only with the latest invention in this line, is especially interesting as showing the care that has been expended for the purpose of producing an instrument that shall carefully adjudicate between consumer and producer.

It may be worthy of notice that the Lyceum is lighted for the occasion by means of a separate dynamo set up in an adjoining building. There is also a three-wire system for connection with the Thirty-ninth street electric station, and this can be used in case of accident to the separate dynamo, a switch being ready for instantaneous action. Thus all the power that is necessary may be had, as either or both of these plants are ready for separate or joint operation.

In the basement is a minature electric railway. Two trains, lighted and propelled by electricity, are kept continually running on a circular double track. The sight is a pretty one as the visitor descends the stairway. The tracks are surrounded with country landscape, and the quickly moving trains, brilliantly illuminated, and rushing smoothly along, their lights of different and bright colors, give a kaleidoscopic impression.

The main feature of the entire exhibit is not here, however, but in a smaller room just off the large auditorium. In this room are fitted up a number of curtained booths, in each of which is an Edison phonograph. Each phonograph is attended by an assistant, and the visitors are invited to insert the vulcanite ends of the rubber tubes in their ears and listen to the reproduction of the human voice by this marvelous invention. If the auditorium was crowded these places were "jammed." The band of ladies playing the mandolin, the Hungarian string band, may discourse their sweetest strains, Mlle. Merie may even blow most melodiously in her cornet solos; but the sometimes harsher music of the small waxen rolls attracts and holds as many as can pack themselves into the overcrowded phonograph room.

On five of the instruments are placed rolls that have received the impressions of music, and on four, those of conversation. There are two phonographs connected with telephones, and the sounds are in this manner transmitted to a resonator in the basement.

Dr. Wangemann is in charge of this department. In all the world there is probably no other man, except the great inventor, who knows so much of the phonograph as Dr. Wangemann. Representing the laboratory, he has traveled all over the continent, giving expositions of the instruments to most of the famous personages of Europe. Dr. Wangemann has brought back with him many mementoes of his interviews with Europe's celebrities. Some of these consist of waxen rolls of the phonograph that have registered the voices of famous statesmen, of diplomats and of singers.

Setting the machine and applying the tubes to the ears, many beautiful, interesting, and laughable sounds could be heard. From one roll would be heard the sound of a famous poet, another would sing with the voice of a prima donna, one reproduced the voice of a man now dead, and another gave the wail of a baby who had never left the continent.

Dr. Wangemann showed how the machines that are now in use in down-town offices could, by an expert, be so adjusted as to receive perfectly, and as perfectly reproduce, the sounds of music. He said the time is coming when the business man will have the phonograph in his office as much as a matter of course as he now has the telephone; and, too, that he may learn by experience to let its inner workings as severely alone as he now lets alone those of the telephone.

In a small laboratory-like room in the basement, Dr. Wangemann has his workshop. Here, also, are a piano and a sound-transmitter. By attaching the latter to the phonograph, the sound of the piano as it is played, or the voice speaking or singing, is faithfully recorded for reproduction. Some famous artists are entertained in this room, where they play and sing, and the sound is preserved by the phonograph.

GENERAL VIEW OF THE LENOX LYCEUM ELECTRICAL EXHIBITION.

For a closing word all that has been said in the beginning of this article may be repeated here. Novice or expert, whoever goes to this exhibition returns therefrom with knowledge gained and pleasure experienced; the novice because all is so new, the expert because the phonograph has never before been so nearly perfect, and never before so well exhibited. And if the expert has had the happiness of being entertained by courteous and obliging Dr. Wangemann, and has listened to his explanations and prognostications of the success of the phonograph, he will have learned more than he ever before knew concerning this wonderful instrument, for the Doctor explains what has never previously been shown, and hints at knowledge possessed that is not now for the general public, but which will soon be theirs in an improved instrument.

Great credit is due to the gentlemen that have exercised their skill and ingenuity in the preparation of this exhibit. The selection and the arrangement of them, the lighting for practical use and effect, the smooth manner in which everything works, the convenient way in which every article is placed for examination, and the courtesy of the gentlemen who have been chosen as expositors of the exhibit, show familiarity with their subject, and ability to carry out the plans that their best judgment suggests.

The Resistance of Conductors to Transient Currents.

At a recent meeting of the Royal Society of Edinburgh, Sir William Thomson read a paper recounting an illustration of the effective ohmic resistance to a transient electric current through a steel bar. He said that at the recent meeting of the British Association at Newcastle Lord Armstrong had told him of an interesting incident. A bar of steel about a foot long, which he (Lord Armstrong) was holding in his hand, was allowed accidentally to come in contact with the two terminals of a dynamo. He instantly felt a painful sensation of burning, and he let the bar drop. He found his fingers where they had been in contact with the bar severely blistered. The bar was found immediately afterward to be quite cold. This proved the outer surface of the steel to have been intensely heated, and that not enough of heat was generated to sensibly warm the whole bar. Lord Armstrong had sent him the bar and some further details. There were two hollows burned out of the metal at the points where the bar touched the terminals of the dynamo. Lord Armstrong had held the bar midway between the two marks. It was perfectly cold three or four seconds after he dropped it. The dynamo gave a current of 85 ampères, at a difference of potential of 103 volts. Sir William Thomson then showed how the theory involved could be worked out by Maxwell's fundamental equations of electro-magnetism. He discussed the theory at some length, and showed that there was a thermal analogy.

The Laurent-Cely Accumulator.

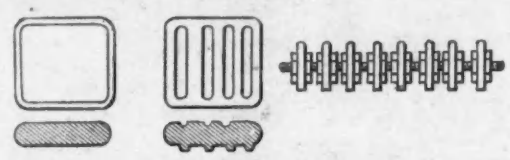
The Laurent-Cely accumulator is constructed and exploited by the Société Anonyme pour le Travail Electrique des Métaux, which is, as is well known, a branch of the Société pour la Transmission Electrique de la Force, of which Messrs. Rothschild Brothers are the promoters.

The special features of the Laurent-Cely accumulator consist in the peculiar nature of the lead paste employed, and in the manner in which it is applied to the plates. The active element is a mixture of chloride of lead and chloride of zinc. The fused chloride of lead has a density of 5.6; by incorporating chloride of zinc with it in certain proportions the density is reduced to 4.5. This mixture, brought to a state of fusion, is run into cast-iron molds in the form of small buttons with rounded edges; these are either smooth or grooved on the surface, as shown in Figs. 1 and 2. After cooling, the buttons are washed to remove the chloride of zinc, and thus to render them somewhat porous. Their density then varies from 4.2 to 3.4.

The buttons that serve for the manufacture of the negative plates are then arranged in a metallic mold into which antimonial lead is run; this surrounds the buttons with a frame that holds them fixed in their positions. The plate presents the appearance represented in Fig. 3. The negative plates thus formed are mounted in cells filled with acidulated water and provided with soluble electrodes of zinc. The composite and zinc plates are connected together in short circuit, and a current is set up. The hydrogen which is disengaged upon the positive electrode reduces the chloride of lead to the metallic state. There are thus obtained buttons of spongy lead of a density between 2.5 and 3.1, while that of ordinary lead is 11.35. Consequently the lead of the Laurent-Cely accumulator is four times less dense than ordinary lead.

The buttons used in the manufacture of the positive plates are first transformed into spongy lead, then heated in the air to oxidize them, and transformed into spongy litharge. They are fixed, like the negative buttons, in a frame of antimonial lead. The formation of the plates takes place in the ordinary way. The buttons of litharge are transformed into peroxide of lead, having a density below 5.

As shown in Fig. 3, the positive and negative plates are provided with a tail, which enables them to be mounted upon an axis, on which they are fixed and secured by two bolts. Each plate is maintained in place in a groove or slide. To this end the two lateral edges slide between two grooved cylinders, which limit their displacement, while the bottom edge rests upon two longitudinal ribs provided with grooves (Fig. 4). The positive and negative plates are placed alternately in corresponding grooves, with their tails turned opposite ways and fitted to the conductors,



Figs. 1, 2 and 3.—Laurent-Cely Accumulator.

which are clamped into the notches. Fig. 5 illustrates how the clamping is effected. In the two principal types of batteries the plates are of the following dimensions: (1) 8½ inches by 8½ inches by .4 inches; (2) 17 inches by 17 inches by .4 inches.

The accumulator has been tried for a long time on the telegraph service of the Chemin de Fur du Nord, under the direction of M. Eug. Sartiaux. These trials extended over eighteen months with a battery of which each cell had 55 pounds of plates. The battery served to work a dynamo which operated an electric capstan, and the result was so satisfactory that M. Sartiaux decided to extend the use of electric capstans all over the company's line. The same accumulator is also employed for the lighting of the *wagons lits*.

The charge of these accumulators is .5 ampère for 2.2 pounds of plate. The charging terminates when the hydrogen commences to disengage itself at the negative plate in very fine bubbles, and the oxygen comes off from the positive plate in large bubbles. During discharge the output should not exceed one ampère per 2.2 pounds of plate. This may, on emergency, be increased to four or five ampères, but the efficiency then decreases sensibly. The available charge is exhausted when the difference of potential at the terminals of one of the cells falls below 1.75 volts.

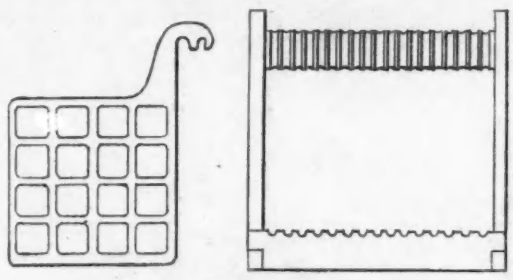


Fig. 4 and 5.—Details of Cells.

Storage Battery Traction in Brussels.

A few months ago a report was made by the Brussels Tramways Company on the cost of the storage battery traction employed on part of their lines. That report was distinctly unfavorable, showing that the cost of furnishing motive power by storage batteries was much greater than with horses, being no less than 8 cents per car mile.

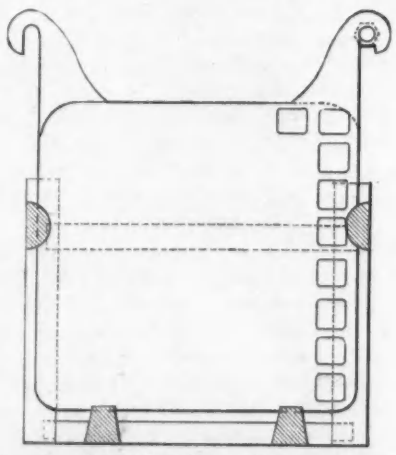


Fig. 6.—Laurent-Cely Accumulator.

This figure was based on nearly four years of careful trial. Now comes the sequel. At a recent meeting of the company it was resolved to discontinue the storage battery service and go back to horses. The reason assigned for the apparently retrogressive move is the very practical one that the financial result of their four years' trial was a deficit of about $5,700. Part of this was stated to be due to the modifications that experience showed to be necessary to the method, and, in general, to experiments. In addition, it is clear that inasmuch as only three cars were in service, while the central station was equipped for eight, the power was not supplied under the most advantageous conditions as to economy. In spite of this, the company considers that the result of its unfortunate experience has been to demonstrate that in spite of the improvements that may be made in the accumulators and motors, the method is not commercially practicable on their road. Hence, on and after May 1 horses will exclusively be used on their lines.

The newspapers of the city have been almost unanimous in condemning the step backward, and go into estimates to show that the company is wrong, and that in reality, *aside from the maintenance of the accumulators*, the cost per car mile is as low with accumulators as with horses. Some of their estimates even give a trifling balance in favor of electricity, barring the above unpleasant factor. *L'Ingénieur-Conseil* takes up the question at no little length, and while it estimates the expense of traction by horses and by accumulators as equal, throws some new light on the matter by calling attention to the fact that an ultra-conservative minority of the Administrative Council of the company has all along been most bitter in its opposition to the use of electricity. This minority has in course of time become a majority, and taking as an excuse the deficit caused by small service and experimental expenses, has expelled the long-hated modern innovation. Of course, from this distance we cannot judge of the inner motives which have prompted this recent action, but we may well consider it in the light of certain rumors recently circulated in this country. A report was assiduously spread not long ago, that a certain large electric railroad was discouraged with the losses incurred through the use of electricity, and was going back to horses. This report proved to be a gross mistatement, circulated for commercial purposes, and figures now well known to the American public show in a most satisfactory manner that electric traction by the overhead system is economical. In fact, if an electric road does not pay it is either because the traffic is not great enough to warrant the building of any tramway, or because of mismanagement.

It is a very difficult matter to form a correct opinion as to the real cost of traction by storage batteries. It is pretty clear, in spite of internal dissensions, that the storage system was given a sufficiently long trial in Brussels, and that under the conditions there existing it was distinctly uneconomical. The cost per car mile as deduced from experience, was about 8 cents, while the estimates of expenses made by enemies and friends ranged from nearly 14 to about 7 cents per car mile—on the whole at least as great as the cost of traction by horses. Comparing this with the American figures on the cost of operating the overhead system, which a fair average of several roads gives as 5 cents per car mile, it is evident that unless electric power and labor is distinctly cheaper here than in Belgium, the overhead system can be operated at least a third cheaper than the storage system, which agrees fairly well with estimates based on the relative commercial efficiencies of the two systems.

It should be remembered, however, that the conditions in the Brussels tramway were not favorable to economy. The grades were severe for a storage system, and the roadbed by no means of the best. Besides this, the stage of experimentation is always an expensive one, and even afterward the early commercial applications are sure to meet with unforeseen difficulties that consume time and money. The amount spent in this country to elaborate our present electric railway was enormous. Laboratory experiments tell so little about the real elements of success, that this costly process of evolution can never be entirely avoided. It is not surprising, then, to find that the experience with storage batteries in Brussels has been a costly one. Whether the prediction of *L'Ingenieur-Conseil* that the company deserted the system on the point of success and will be driven back to it within five years, time only can tell; but if such is the case it will not be the first time that a company has toiled through the unsuccessful stage of a valuable system, only to throw it aside just in time to see their labor turned to account by others.

The question of storage battery traction is still an open one, and an opinion should not be too hastily formed from this adverse report. Even if it should ultimately prove to be no cheaper than horse power, it is by no means certain that it may not come into extensive use. It certainly is to be desired on the score of cleanliness, and as *L'Ingenieur-Conseil* suggests, a single epidemic among horses would have made the company think twice before coming to their present conclusion. Steam engines and dynamos do not have the epizootic, and paralysis of surface transit is a possibility too serious to be overlooked.

If experience should show that the objections to the use of the overhead system in city streets is well taken, the storage battery may become a formidable competitor for the place now divided between horses and cables. Cable traction in cities of the size in which overhead wires would be forbidden is reasonably reliable and undeniably cheap. Its first cost is, however, so great, that the storage system would not be barred out by its lower efficiency. With a storage battery of fairly light weight and good life, there is a wide field in urban traction. It is to be hoped that we shall soon have detailed reports of the performance of some of our American storage battery systems, for, from the interest at present displayed in the subject, there is every reason to believe that tests on a commercial scale will soon be forthcoming—very possibly in New York city, where the Julien Company is proposing to extend its operations very considerably. There is no place where a successful and widespread storage system would be more welcome.

The Crocker-Wheeler Perfected Arc Current Motor.

In no instance has the proverb "necessity is the mother of invention" been more aptly exemplified than in the development of the electric motor. In every great invention the first effort has always been to utilize a certain idea or force, and so adapt it as to make it of practical use; the next, to broaden its field of usefulness and utilize it on the most economical basis. To this general rule the development of the electric motor has not been an exception.

It was demonstrated that electrical energy could be generated, transmitted to a distance, and converted into power of a most convenient form by means of electric motors of the constant potential type, using what is known as a low tension current. The utilization of electricity for this purpose was surrounded with difficulties which, while very great, were so obviated that to-day thousands of industries entirely depend upon it for their motive force. But as, for reasons that are plainly manifest, using simply this one form of electricity for power purposes would circumscribe and confine to very narrow limits a force that otherwise might be made an important factor in commerce, the necessity for using the high tension or constant current became apparent, and various motors have been devised to meet this demand.

To supply this demand, Mr F. B. Crocker and Mr. S. S. Wheeler, both of whom are well known experts in the field of electric motors, have produced a self-regulating constant current motor that overcomes many previously existing obstacles. It makes the arc current serviceable for power purposes in the many localities where no other current is available, as well as in sparsely settled districts, where it is not possible to obtain power from constant potential circuits.

Heretofore attempts have been made to regulate such motors by changing the magnetic strength of this field,

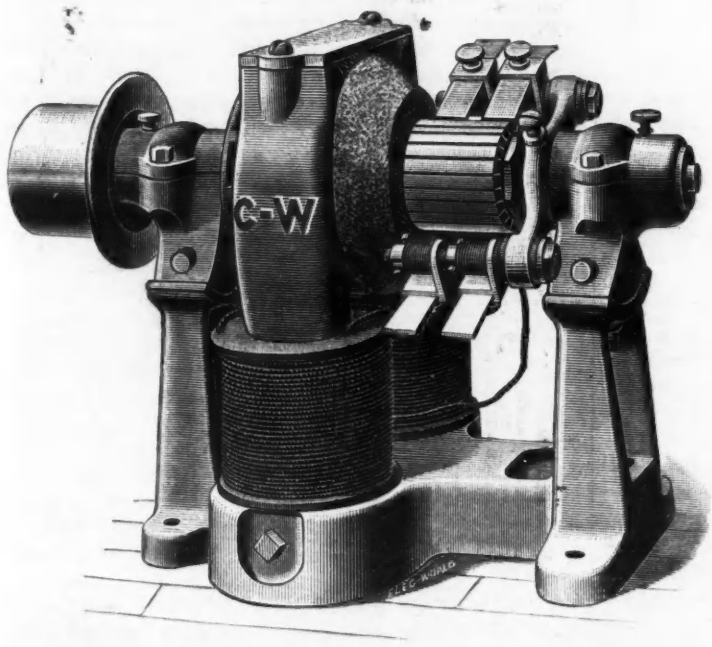


FIG. 1.—CROCKER-WHEELER NEW ARC MOTOR.

FIG. 2.—SAFETY RHEOSTAT.

but this arrangement is likely to cause the serious defect of sparking at the commutator, and does not admit of instantaneous regulation. This latter is apparent, for an appreciable time must elapse before the change of strength of the magnetism can exert itself, and the machine will "race" before the governor can control it. In the motor under consideration these difficulties are overcome, as the regulation is effected by moving the armature shaft on its bearings in and out of the field, thus instantly increasing or diminishing, proportionate to the load, the amount of torque. Unvarying speed is thus obtained, even under varying load or current. By this arrangement is avoided the shifting of the line of commutation, and the result is the entire absence of sparking. The moving of the armature shaft, which is controlled by a mechanical device, also distributes evenly the wear on both the bearings and the commutator. The electrical conditions of the machine are thus undisturbed, so that a continuous current is maintained throughout the circuit, and the armature may be at rest for any length of time, with the full strength of the current flowing through it, and yet sustain no injury. In running pumps and elevators this property is particularly advantageous, and it is one of the essentials in which this motor differs from the constant potential motor, which is destroyed if the full pressure of the current meets the armature for even a short period while the armature is at rest.

The speed of the motor will not change with a varying current, even though the range be from 10 to 5 ampères. The ½ h. p. machine shows a difference of potential of less than 50 volts on a 10 ampère circuit, and the 1 h. p. of less than 100 volts.

In small motors the regulation is effected by hand, and in the motors of ½ h. p. and upward, by automatic control. Among the advantages claimed for the Crocker-Wheeler motor by its inventors are the following: Low speed, and consequent long life; cleanliness; economy of current; simplicity; reliability; it cannot be injured by overloading, can be started by a single switch; its parts are few and simple; it is self-oiling; it is arranged for constant speed, variable speed, or for constant load; it may be instantly reversed; its governor is simple, sensitive and reliable, and has no delicate electrical adjustments to get out of order; it is entirely encased within the driving pulley, and cannot

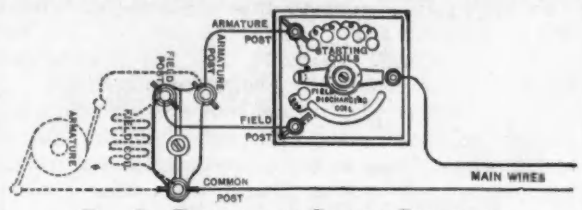


FIG. 3.—DIAGRAM OF SAFETY RHEOSTAT.

relog with dust nor refuse to operate. The construction of the armature renders it impossible for it to become saturated with oil.

New Telephonic Apparatus.

A French inventor, M. Le Goaziou, has just brought out a complete telephonic apparatus which, it is claimed, will entirely avoid the unpleasant crepitations so frequently produced in similar apparatus in which carbon is employed. It belongs to the category of electro-magnetic appliances, and is remarkable for the particular form of the magnetic elements. In the transmitter, the vibrating plate of silvered brass supports in its middle and at its base, a conical bobbin or coil, over which is placed a conical armature of soft iron. The body of the bobbin is made of copper, and the wire rolled in the usual way; while the superpo ature is covered with a layer of electrolytic copper in order to decrease the power of adherence in case it should come into contact with the armature of the second coil. This second bobbin is fixed, and concentric to the first, but it differs from it in so far that the winding and the armature are fixed to the interior surface of a conical case. The ends of the wire are connected to the transmitting wire, and the armature slightly covered with copper. The two bobbins play the part of the two windings of the Ruhmkorff coil in carbon apparatus. If the movable coil or bobbin is animated by a vibrating movement caused by the movement of the vibrating plate, the variable magnetic field will induce currents in the second coil. The receiver is formed of a vibrating plate supporting in its centre and by its top a hollow conical bobbin, the winding and armature being placed in the interior. A permanent magnet, terminating in a soft iron cone, from which it is electrically separated by a plate of brass, completes the apparatus. The variation in the intensity of the current in the bobbin gives rise to attractions varying in intensity between the armature of the bobbin and the soft iron cone, and consequently, to a vibrating movement of the plate.

On the Electrical Resistance of Iron and its Alloys at High Temperatures.*

At high temperatures malleable iron undergoes two molecular reversible transformations, which are characterized by more or less considerable absorptions of heat (M. H. Le Chatelier, *Comptes Rendus*). These transformations were discovered by M. Osmond, who at the time pointed out the importance of the part which they played in the metallurgy of iron. The first, which is only slightly marked, is generated at 730 degrees, that is to say a temperature bordering upon that of the recalescence of steel (700 degrees); the second, which is accompanied by a greater absorption of heat, is produced at 855 degrees.

* From the *Electrical Review*, London.

When dealing with carbureted steel, M. Osmond noticed that the transformation became less marked in importance and lower in temperature proportionally as the carbon increased in amount, until, in the case of hard steel, the transformation became absorbed in the recalescence. It is true, as M. Osmond pointed out, that the method of experiment employed left room for a certain amount of uncertainty as regards this. The reduction and diminution referred to were possibly only apparent, and were the results merely of a kind of partial and transient tempering occasioned by the very rapidity of the cooling process.

It would be interesting to elucidate this question, if only for the connection it has with the tempering, properly so called, of steel. Tempering by water has, according to M. Osmond, the effect of maintaining at the ordinary temperature the varieties of iron and of carbureted iron, which, normally, are stationary at over 860 degrees and 700 degrees. Tempering by means of lead would merely maintain the variety of iron in its condition of unstability, and would be no hindrance to the normal transformation of the carbureted iron in the cooling process.

In order to obviate the difficulty, we must have recourse to these properties of iron which vary with the temperature, but whose measurement it is possible to take at a stationary temperature when sufficient time has elapsed to allow of the metal acquiring its condition of fixed equilibrium.

Measurements of expansion taken for this purpose lead to no precise result; the abrupt variations in length which formed the subject of observation were of a degree analogous, as regards magnitude, to that of experimental errors. I then undertook the study of electric resistances, and the results of my experiments are shown in the following tables and figures, and are supplemented by others having reference to nickel and platinum. Resistances are expressed in ohms, and have reference to wires of 1 metre in length and 1 millimetre in diameter. All the experiments, except those with platinum, were made in pure and dry hydrogen.

Very pure malleable iron: C = 0.05 per 100.
Scoria inserted about 1 per 100.

t.....	15°	290	460	750	800	860	910	1068
r.....	0.13	0.38	0.59	1.10	1.21	1.31	1.34	1.40

Fused steel: C = 0.6 per 100.
M_n = 0.4 per 100.

t	15°	300	420	600	700	820	960	1100
r	0.16	0.43	0.55	0.80	0.97	1.28	1.32	1.34

Hard Steel.

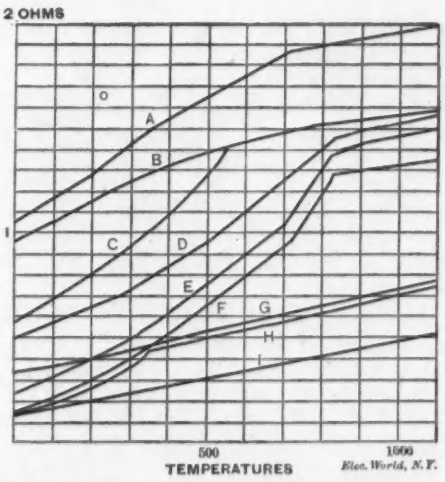
t.....	15°	280	410	680	730	830	870	940	1050
r.....	0 24	0.46	0.60	1.06	1.13	1 39	1.43	1.46	1.48

The curves in relation to the iron and to the steels, properly so called, indicate very clearly, by the angular points developed by them, the two molecular transformations, and, moreover, make it apparent that the temperatures of these transformations are independent of the proportion of extraneous ferruginous substances.

Manganese steel with 13 per cent. of manganese, which is not really a steel, but an alloy of iron and manganese, presented a rather doubtful angular point at about 700 degrees. I propose to return to them when investigating the action of the tempering that produced such curious effects upon this metal.

Nickel furnished a very well defined angular point at about 340 degrees.

Platinum and rhodium-platinum, which were employed in the construction of my thermo-electric couples, presented a resistance which increased proportionally with the temperature.



Elec. World, N.Y.

A, Manganese steel, with 13 per cent. manganese.
B, Ferronickel, with 25 per cent. nickel.
C, Ferronickel modified.
D, Steel, with 3 per cent silicon.
E, Hard steel.
F, Steel, semi-hard.
G, Platinum with 10 per cent. rhodium.
H, Nickel.
I, Pure platinum.

RESISTANCE CURVES AT HIGH TEMPERATURES.

Ferro-nickel with 25 per cent of nickel, furnished some very interesting phenomena. Heated in pure and dry hydrogen it underwent no alteration, and its curve of resistance remained perfectly regular without presenting any angular point; on the other hand, when heated in damp hydrogen it underwent an important modification. Its color, from yellowish gray became steel gray, while its mechanical properties underwent the following transformations: The tenacity rose from 65 kilograms to 80 kilograms; the extent of the break from 65 per cent. fell to close upon *nil*, and lastly, the elastic strain limit became more than doubled. The electric resistance

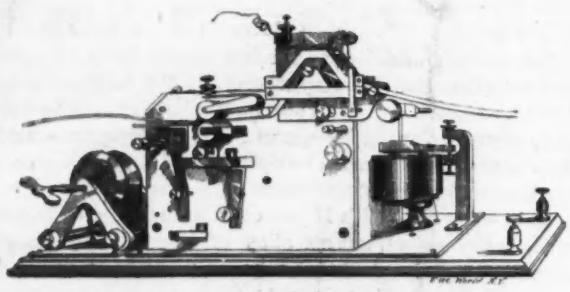
was then diminished by one-third. The resistance curve of the new metal gave, when heated, an angular point at 550 degrees; and, moreover, was superposed to the normal ferronickel curve. In the cooling process the two curves remained superposed up to about 100 degrees; but thereafter the resistance diminished progressively to rejoin the curve of modified metal. There was, therefore, during the cooling, a delay in the transformation analogous to that produced by the tempering in the case of the steels, but it was impossible to avoid this, even with very slow cooling. This change wrought in the ferronickel by the damp hydrogen appeared to be due to the oxidation of the silicium, an element which enters to a slight extent into the composition of this alloy.

Since completing the above experiments I have become aware of a similar investigation by Dr. Hopkinson, which has been published in the *Philosophical Transactions of the Royal Society* for 1889, but not yet circulated. His experiments had reference to malleable iron, semi-hard steel and manganese steel. He found, at 855 degrees and 815 degrees, the points of transformation of iron which were obtained by me at 850 degrees and 820 degrees. But he failed to detect the point of transformation at 710 degrees, either in the hard or in the manganese steel.

The Fast Sending Telegraphic Contest.

The national fast telegraphing tournament, which took place at Hardman Hall, this city, on Thursday, April 10, was a most unqualified success. It drew together an exceptionally large audience of telegraphic experts from all parts of the country, and ended by breaking the existing records for speed and giving a display of expert telegraphy that was singularly interesting. Conspicuous among the spectators were many well-known telegraphers of this city, including not a few distinguished old timers, like General Thomas T. Eckert and Mr. E. H. Johnson. Mr. Edison had promised to be present, but at the last moment was unfortunately compelled to send regrets.

The hall was equipped with an elaborate variety of telegraphic apparatus. The platform at the farther end contained a table for the contestants, furnished with three keys each, in different positions, of the New Haven, the Bunnell, the Victor and the Steiner or Western Electric make, so that those who had a preference for any particular key



Automatic Repeater used in the Tournament.

or position could readily gratify it. Near by was a typewriter, on which the matter sent was taken down verbatim. Close to this was an ingenious device, recently invented by P. B. Delany, for recording the precise number of pulsations made by each operator, while in a room back of the platform was a register with an attachment, the invention of Mr. W. P. Phillips, whereby a record was made of what each of the experts did, in such a manner that the matter transmitted could afterward be reproduced at any time exactly as it was sent at the time of the trial.

Back of the contestants was the judges' table, where Messrs. Phillips, Taltavall, Usher, Howell and Holbrook followed the progress of the tournament by the aid of a sounder placed on the table for their benefit. Other sounders were distributed along the sides of the room, so that any one in the audience who wished could, more or less readily as his skill allowed, note the performance of each contestant.

The prizes were offered for the fastest work—for the greatest number of words sent in five minutes, provided the sending was readable. The copy used was a printed slip with which the contestants had been allowed to familiarize themselves. The matter it contained, however, was evidently not selected because the words in it were short, but rather the reverse, and the good time made was all the more creditable on this account.

At 2 o'clock in the afternoon the tournament opened with a telegraphic address of welcome by Mr. Catlin, in which among other things he said:

"These 'Battles of the Keys,' ever growing more important and dignified, exert a wider influence for the general good than is apparent to the lay observer. The telegraph has frequently been called the right arm of the press, and I venture to christen the press the 'phonograph of the telegraph.' What the telegraph once breathes into existence, the press perpetuates to posterity, to eternity. Abreast with the marvels of the telescope, which elongate the human vision till the eye scrapes the very dome of heaven itself in the search after knowledge, an equally important part is that played by the telegraph key, with its hardened platinum larynx meshing the entire world in a net of living, vibrating intelligence, keeping in unison the metaphysical circumference of the globe."

Mr. C. W. Price, who acted as master of ceremonies as well as starter, read a telegram to Mr. Catlin from Mr. John I. Sabin, of San Francisco, offering the same prizes, on the same conditions, as those offered by the United Press, and one to Mr. T. C. Martin from Mr. James D. Reid, of Dunfermline, Scotland, offering a handsome Cairngorm brooch to the most successful lady contestant.

Mr. Price then announced that the ladies' class would first be called to the key, each competitor having a five-minute trial in turn. The rapid, clear and excellent sending of the ladies elicited the highest commendation. An old timer present, who has been out of the practical telegraphic business for many years, but is familiar with the operators and systems in European countries, was evidently surprised as well as pleased when Miss Stephenson showed a speed of 217 words in the five minutes, an average of 43 words a minute. In fact he became quite enthusiastic on the subject, and declared that nowhere else in the world could lady operators be found to equal in speed and accuracy those who competed for the honors that afternoon.

The following is the award of the judges in the ladies' class, with the number of words sent by each of the winners during the five minutes:

First prize, $50, to Miss K. B. Stephenson, 217 words.
Second prize, $40, to Miss B. M. Dennis, 212 words.
Third prize, $20, to Miss E. R. Vanselow, 210 words.
United Press and Sabin prizes for excellence combined with speed, $50, to Miss T. V. Froschel, 200 words.

Next came the old timers' class, open to all who were in the service prior to 1865. The work which was done showed that the older telegraphers had not lost their cunning by any means, for it took 229 words and one character to secure first prize. The award of the judges was as follows:

First prize, $50, to A. S. Ayres, 229 words.
Second prize, $40, to Fred Catlin, 217 words.
United Press and Sabin prizes for excellence combined with speed, $50, to A. S. Ayres.

After the conclusion of this test the audience prepared itself for a display of speed, and was not disappointed, for class A exhibited the fastest Morse that has ever been seen up to date. Some of the best-known telegraphers in the country were in the competition, and the beauty, clearness and rapidity of their sending made the occasion one long to be remembered. A surprise was in store, however, even for the telegraphers themselves, for the prize was secured by a "dark horse" among the contestants, Mr. B. R. Pollock, Jr., train dispatcher of the New York & New England Railroad at Hartford. He started out at a pace that surprised the audience, and not only kept it up, but increased it until at the end of five minutes he had 258 words to his credit, breaking all records and going more than ten words ahead of his nearest competitor.

Although the sending was very rapid, it was not at all as distinct as that of some of the others, and the judges being unable to agree, asked Messrs. Gibson, Roloson, Pollock and F. L. Catlin, son of Mr. Fred. Catlin, manager of the tournament, the four showing the greatest speed, to make another trial. In this second attempt Mr. Pollock beat even his previous record, sending 260 words, just 52 words a minute, while the speed of the other contestants fell off a little. Mr. Gibson, who sent 238 words in the second trial, gave a singularly clear cut and distinct exhibition of speed, every character being easily readable. The remarkably fine quality of his work seemed to some of the judges to counterbalance the greater rapidity of Mr. Pollock, but as there were among the audience (as well as among the judges) those who were willing to say that they could follow the high speed of the man from Hartford, he was awarded the first prize of $100. Mr. Gibson got the second prize, $70, and Mr. F. J. Kihm, who sent 238 words, third prize $30, while Mr. W. L. Waugh, who sent 229, words was given the United Press and Sabin prizes.

In class B, open to all, barring those who had sent 500 words inside of eleven minutes, Mr. F. L. Catlin broke the record up to the date of this tournament by sending 251 words in the five minutes. The award in this class was:

First prize, $85, to F. L. Catlin, 251 words.
Second prize, $65, to W. L. Waugh, 229 words.
Third prize, $30, to Frank English, 225 words.
United Press and Sabin prizes for excellence combined with speed, $50, to J. P. Bradt, 220 words.

The prize offered by Messrs. Albert B. Chandler and Fred. Catlin, $20, for the most perfect sending regardless of speed, was awarded to A. S. Ayres.

The prize offered by Messrs. Chandler and Catlin, $20, to receiving operator who made the best pen and ink copy from W. L. Waugh's transmission, was competed for only by Mr. Thomas R. Taltavall, whose copy was pronounced by the judges the finest high speed writing they had ever seen.

Of the keys used, that manufactured by the New Haven Clock Company seems to have been the favorite with the fair sex, for eight of the ladies chose it, while three used the Bunnell, one the Victor, and one the Steiner. Of the men, eighteen selected the Victor key, nine the Steiner, seven the Bunnell, and five the New Haven.

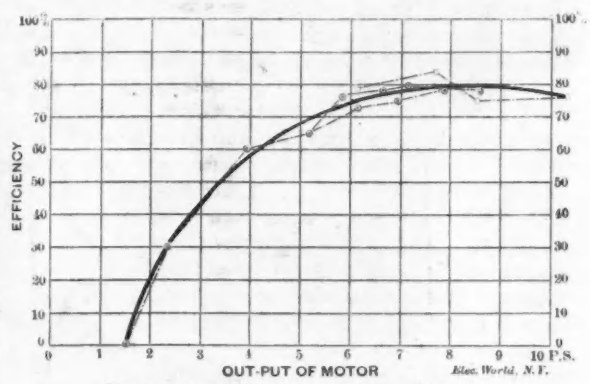
The handsome stop watch by which the contestants were timed was loaned for the occasion by the manufacturer, Mr. Kendall Smith, of Newark, through Mr. E. M. Anson, who acts as agent for Mr. Smith at the Western Union main office.

Messrs. Waugh, Kihm and Gibson say that it would be impossible for an operator not previously familiar with the matter to read the sending of Mr. Pollock when he transmitted fifty-two words a minute, and that consequently his sending at the tournament was not a fair test of his ability as a fast operator. They have, therefore, decided to arrange a sweepstake of $100, open to all the world, particularly to Mr. Pollock, to send 1,000 words of regular press matter not to be seen by the contestants until the start. Mr. Charles H. Summers, of Shriever, La., also challenges Mr. Pollock to transmit 100 words for a purse of $500.

The work throughout the tournament was remarkably good, and the record for speed that was established will probably stand for a long time before it is beaten. As mentioned above, the sending was registered in three distinct ways. It was received on a type-writer, registered on a Morse receiver, and finally the separate impulses required to produce the characters were recorded. The tapes containing the record of the Morse receiver were preserved, and the next morning they were reproduced by a special instrument which is shown in our cut. As will be seen, it is simply an attachment to an ordinary Morse receiver, consisting of a smooth surface over which the paper tape is passed, with the indented side down, and a bent lever, of which the vertical arm forms a knife edge resting on the tape, and the horizontal arm forms a contact key operating the circuit connected with an ordinary sounder. As the clockwork passes the tape under the knife edge, every indentation represented on the upward side of the paper by a raised mark lifts the knife edge and makes contact in the local circuit, consequently reproducing in the most perfect manner the record that had previously been impressed upon the tape.

Test of a Ganz 5 H. P. Alternating Motor

We present this week the efficiency curve obtained in the Frankfort test of a 5 h. p. alternating current motor, Ganz & Co. The method employed in testing it was the same as that used in the previous experiments, using the motor to drive a continuous current machine provided with vary-



Efficiency Curve of Ganz Motor.

ing load by means of a bank of incandescent lamps. Currents applied to the motor and the electrical out-put of the driven machine were ascertained by proper means (the motor being operated to a transformer current of 100 to 105 volts), and the curve shows the result of the test. It will be seen that a very satisfactory efficiency was obtained, as in the case of the larger motor previously tested. At its normal out-put the efficiency of the motor was about 76 per cent., the efficiency increasing to a little less than 80 per cent. The motor stood overloading at about the same ratio as the 25 h. p. motor previously described. It will be seen by this curve, that with 4,940 complete reversals of the primary machine, the motor runs 1,235 turns per minute.

It will be seen that the formation of this motor resembles very closely that of the larger motor in every respect except its efficiency is not quite so high. The efficiency, however, is quite satisfactory for a machine so small, although it doesn't reach quite as high figure as in a first class continuous current motor of the same number horse power The difference in one respect, however, is very material between continuous and alternating motors. These alternating motors when loaded up to approximately twice their normal capacity are dragged out of synchronism and stopped, while the continuous current machine can be overloaded to a far greater extent for a brief space of time without any other evil result than a somewhat lessened efficiency.

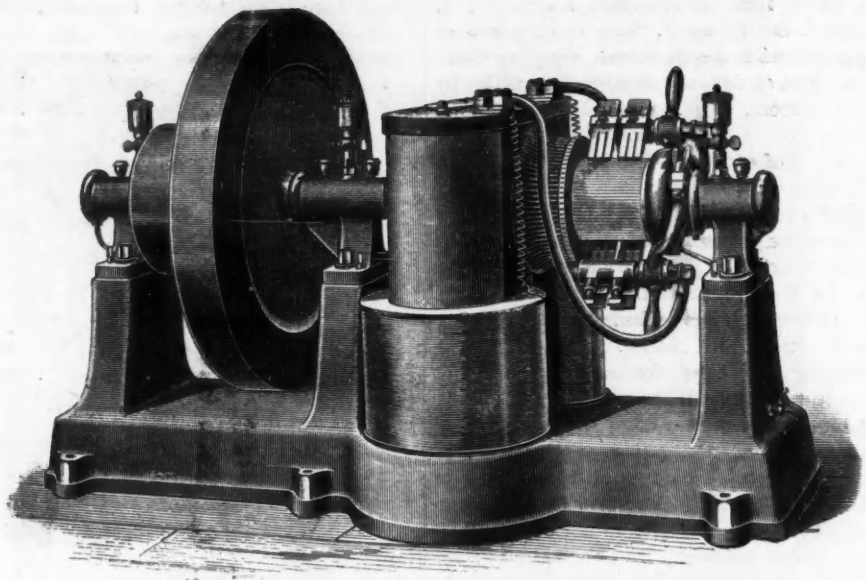
The performance of this Ganz motor, however, gives great promise for better results in the future, provided only the difficulty of sparking on the start is obviated.

New Application of Electricity.

By some chance a copy of an electrical paper found its way into the hands of a Thames' bargee, who, strange to say, cast his eye over it. There he found a mention of an automatic electric leak-finder. He went to his owner, pointed the passage out to him, and said, "I wish you'd get me one of them —— things to find the leaks in my —— barge. There's always some new ones to wet the cargo, and it's a —— of a trouble to have to work for 'em oneself?"

A Dynamo for Use with Gas Engines.*

The illustration on this page represents one of Messrs. Charlesworth, Hall & Co.'s dynamos, which has been specially designed for driving from a gas engine. These machines are carefully designed mechanically as well as electrically, and the lubricating arrangements are very convenient and perfect. Each bearing is fitted with a special side-feed lubricator, which is so arranged that the feed, when once adjusted, can be turned on or off without fresh adjustment, and can be increased or decreased at any time when found necessary. Each bearing is also fitted with two simple siphon lubricators, which



SPECIAL DYNAMO FOR USE WITH GAS ENGINES.

are intended to be used if any of the bearings should become heated. The waste oil from the bearings is caught in the enlarged ends of the pedestals, and down into the standards carrying them, and can be drawn out as required. These arrangements keep the machine entirely free from oil except where it is required. The bed-plate has been extended to support the extra weight of the fly wheel, which is 30 in. diameter and weighs about 6 cwt. After being turned all over, this has a wrought hoop, previously bored, shrunk on and then turned up. The shaft is of hard steel, and is 2 in. diameter in the bearings at the pulley end, and 1¾ in. at the other end. The bearings are of aluminum bronze, each 8 in. long. The pulley is 18 in. diameter, and carries an 8 in. belt. The bed-plate is of massive construction and well ribbed, to withstand rough usage in transit and fixing.

The magnet cores are of soft charcoal iron fitted into holes bored through the bed-plate and secured in their places by screws. The pole pieces are in one forging with the magnet cores, and are bored from the pedestals to receive the armature, which is placed exactly in the centre. The armature frame is of strong aluminum brass, and the core, which is 12 inches in diameter, is built up of soft charcoal iron discs insulated from each other, and has an area of 40.5 square inches. The commutator bush is a steel casting with wrought-iron nut and washer, and is 6½ inches diameter; it has 80 hard drawn copper bars, one inch deep, and is insulated entirely with mica. The armature is wound with 200 convolutions of one No. 8 B. W. G., and has a resistance of .045 ohm. The magnet is shunt wound only (for charging accumulators), and each leg is wound with ten layers of No. 14's and sixteen layers of No. 15's, and has a total resistance of 31.6 ohms. There are two brushes on each side of the commutator, each of which can be adjusted independently of the other. These machines work without any sparking, with the full load; when working lamps the normal load is 150 ampères and 100 volts at 670 revolutions per minute, and 150 ampères and 140 volts at 820 revolutions when charging accumulators.

The electrical efficiency, when working lamps as above, is:

Loss in armature	6.2 p. c.
" " magnet	1.94 p. c.
Total loss	8.14 p. c., *i. e.*, 91.86 p. c. efficiency.

or when charging accumulators with 140 volts—

Loss in armature	= 4.474 p. c.
" " magnet	= 2.741 p. c.
Total loss	= 7.215 p. c., *i. e.*, 92.786 p. c. efficiency.

The above machines are 5 ft. long and 2 ft. 8 in. wide, and 3 ft. 6 in. high over all.

* *Industries.*

New Compound Engine.

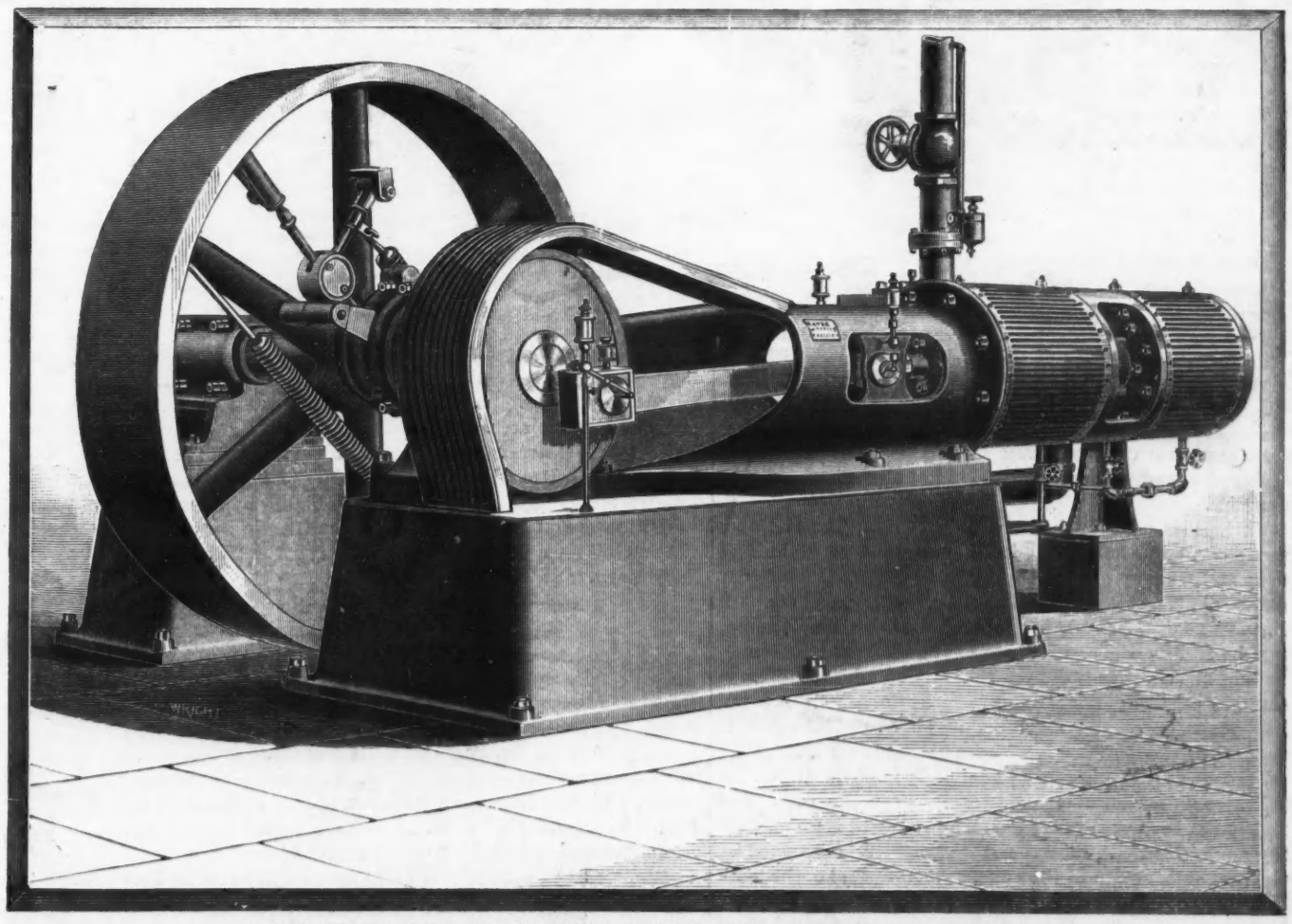
The accompanying cut shows a new type of tandem compound engine, which is designed for high pressure and heavy duty, and is excellently fitted for electrical uses. It is from the shop of B. W. Payne & Sons, Elmira, N. Y.

The compound engine has recently taken a firm hold of electrical circles, and among the various styles in which it is manufactured, the tandem seems to be the most popular, as it is the simpler and cheaper machine.

One of the difficulties of the tandem type is the trouble experienced in getting at the pistons for repacking or other repairs. In the machine shown, the cylinders are so arranged that one can obtain access to either of the pistons by drawing both out through the rear cylinder. The high-pressure cylinder is attached to the frame, and the rear head, together with the front head of the low-pressure cylinder, is passed out through the latter. The piston can then be removed without disconnecting the cylinders. This is a matter of great convenience, and is a distinct improvement on most of the types now in use.

The valves are of the balanced slide variety, the high-pressure valve has the shape of a truncated wedge, and has a pressure plate at its back. The inclined surface of the wedge is toward the pressure plate. It is thus removed from steam pressure, and is a valve particularly easy to keep in order and admirably balanced. This allows a high steam pressure, which is exceedingly desirable in compound engines as a matter of economy. The high and low pressure valves are operated by independent eccentrics, the high-pressure eccentric being controlled by a shaft governor.

It will be seen that the engine is solidly built, with massive single crank and substantial frame, and the arrangement of the high and low pressure cylinders before described makes it an exceptionally easy matter to arrange them, and manipulate in case of any difficulty.



PAYNE TANDEM COMPOUND ENGINE FOR ELECTRIC LIGHTING.

The engine has already found its way into favorable notice, and would seem especially adapted for electrical service where ease of access to all the working parts is particularly desirable. The solidity of the whole machine specially fits it for heavy duty, and uses where the changes of load are violent and a considerable reserve capacity is desirable.

The Van Rysselberghe System in France.

Official reports say that the Van Rysselberghe system of simultaneous telephonic and telegraphic communication is now actually applied to French telegraph lines aggregating 1,993 kilometres in length. The locations of the various lines are as follows:

	Distance in kilometres.	Length of line going and returning.
Rouen—La Havre	92.000	184.000
Paris—Rheims	298.590	597.180
Rouen—Louviers	42.840	85.680
Paris—Rouen	140.360	280.720
Paris—La Havre	235.660	471.320
Paris—Lille	240.000	480.000
Paris—Marseilles	700.000	1,400.000
Paris—Froutiere, Belge	244.080	488.160
Total	1,993.030	3,987.060

The development of the Van Rysselberghe system has been still more rapid in Belgium, where it has been applied for a total length of 7,206 kilometres. Coming to compare this amount with the extent of Belgian territory, it is very evident that the proverb that no one is a prophet in his own country does not apply in Belgium, at least, in the case of M. Van Rysselberghe.

Paris Electric Tramways.

The following particulars are given of the new electric cars on the Levalois-Madeleine line at Paris. Four cars at present are running. They are fitted with Faure-Sellon-Volckmar accumulators, with twin plates, 108 cells in 12 boxes, containing nine each in series, each cell weighing 33 pounds. The 12 boxes are placed in cupboards at the angles of the cars, four in front and twelve behind. They are grouped in four groups of 27, and can be connected in four manners, one, two, three or four in series. The motor placed under the car is of the Siemens type. Its speed can be 1,600 revolutions, but is usually 1,000, reduced by endless cord gearing of 27 to 1. The reversal of the motor is accomplished by the movement of a handle fitted to the brushes; these are double, and in the form of V, one branch of the V corresponding to the forward and the other to the backward motion. The car weighs 7,700 pounds, it carries 3,500 pounds of accumulators, and can carry 50 passengers. At the normal speed of eight miles an hour, the electric energy necessary is as follows: on the level 4.5 h. p. (16 amp. × 200 v.); on a rise of one per cent. 8 h. p. (29 amp. × 200 v.), and two per cent. 11 h. p. (42 amp. × 200 v.). At the speed of 4½ miles an hour: on the rise of three per cent. 12.5 h. p. (46 amp. × 200 v.), and four per cent. 15.5 h. p. (57 amp. × 200 v.). At the speed of 3½ miles an hour: with a rise of five per cent. 10.5 h. p. (38 amp. × 200 v.), and 5.5 per cent. 11 h. p. (40 amp. × 200 v.).

New Telegraphic Cables.

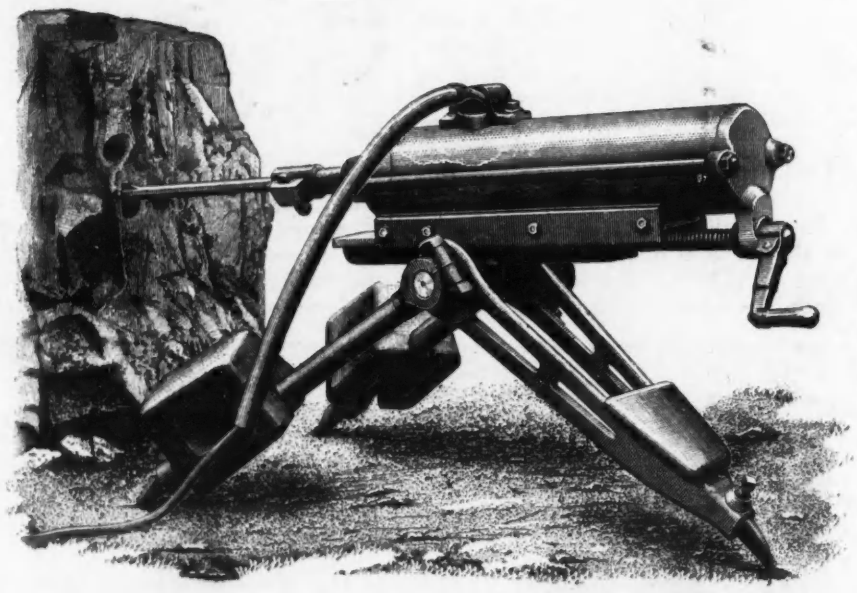
The island of Guadaloupe has been connected with Martinique since the 2d of February, by a cable laid down by a French company. This communication will be completed by a special line connecting Mariegaulite with Guadaloupe, and the French company is arranging to establish another cable between France and England. And beside that, a project is on foot for establishing two new submarine cables, one of them between Marseilles and Oran, and the other between Marseilles and Tunis.

A New Electric Drill.

The Marvin system of electric percussion tools, which will extend the number of industries to which electricity is applied, is the invention of H. N. Marvin of Syracuse, N. Y.

The system consists in reciprocating an iron bar axially between two solenoids intermittently energized by pulsations of current delivered to the two coils in alternation over separate circuits, from a special dynamo. The movement thus developed may be applied to a variriety of operations, and the simplicity of the machine renders it suitable for use in exposed localities. For some time there has been a demand for a simple and effective percussion drill operated directly by the electric current, and the Marvin system appears to afford such a drill.

The drill consists of two solenoids mounted in a boiler tube casing, and the whole mounted upon an adjustable support. An iron bar reciprocates axially through the solenoids under the iufluence of their alternate attraction, and to this iron bar is connected a drill. As the coils are alternately supplied with pulsations of current over separate circuits from a special dynamo, no commutating devices or sliding contacts are required either upon the drill or in its



MARVIN ELECTRIC DRILL.

vicinity. There is nothing corresponding to a valve action. The moving parts are simply an iron rod traveling axially, and a ratchet arrangement that serves to turn the drill slightly at each stroke. There are no parts liable to injury from exposure or rough handling. The whole machine is designed to endure the roughest kind of abuse in mines and quarries.

Various sizes of machines will be built. The size now ready is capable of drilling holes from one to eight feet deep and from one to two inches in diameter. It will cut about eight feet per hour in granite, and requires about 5 h. p. The drill travels in synchronism with the dynamo, and by feeding the machine up to the rock the stroke may be made as short as is desired for starting a hole, while the number of strokes per minute remains the same. A peculiar property of the machine, and one of great value, is that when the machine is withdrawn out of striking range of the rock the plunger immediately loses its stroke. It takes up a position about midway between the coils, and its motion becomes a mere quivering. There is no pounding against buffers, as the rod is perfectly cushioned by the magnetic action of the coils. At full stroke the drill has an excursion of about four inches, and strikes 650 blows per minute. It is of about the same weight and bulk as an air drill of the same capacity.

The lack of a practical percussion drill has retarded the introduction of other electrical mining appliances, because mine owners hesitated to apply electricity to pumping, hoisting, etc., while they were at the same time compelled to maintain an air compressing plant for their drills. The invention of the Marvin drill enables the miner entirely to dispense with his air compressor, and perform all his mining operations from one source of electrical energy.

In many instances, mines in which the drilling is now done by hand may be operated at a greatly increased profit by connecting them by wire with some source of energy inaccessible by present methods. A great variety of pounding tools may be operated to advantage by this system.

The Sprague Electric Railway & Motor Co., of New York, have secured the control of this system in the United States, and the Marvin Electric Drill Co., of Syracuse, N. Y., are the owners of the patents in this country and abroad.

A New Field for Electrical Welding.

It has heretofore been remarked that the Thomson Electric Welding Company had taken out patents which might form the basis for the organization of a new welding company, but particulars have not until now been accessible. It appears that about four months ago Lieut. W. M. Wood, of the United States navy, who is on leave of absence, and associated with the Thomson Welding Company, conceived the idea of manufacturing projectiles by the electric welding process, with a view to secure better results than have heretofore been obtained by any other process, and at a saving of expense. The idea was wrought out, and patents for the purpose have been granted. Heretofore the government has had to bore solid metal at great cost. By the process as governed by the patents a steel tube of the proper length and thickness is welded to the head and then to the butt of the shell, thus in a few moments accomplishing what now requires hours of costly machine labor. The process is varied according to the class of shell or shrapnel to be manufactured, all details of which are covered by the patents which the company holds. It is the plan of the management to organize a separate company to develop these special patents, the revenues of which shall flow directly to the stockholders of the Thomson Welding Company, and as the necessary experimenting has been done, active measures will be taken to commence manufacturing without delay, the works to be located at Lynn. Large contracts for government shell are already awaiting the formation of the company. The Thomson Electric Welding Company has taken out similar patents in all foreign countries, and that department will receive attention 'ater. The old or parent electric welding company is arranging to supply welding plants at the navy yards in Brooklyn, Norfolk and Washington, and a dispatch to-day says that an item of $12,000 has been reported to the House by the Naval Committee in the appropriation bill for a chain welding plant for the Charleston Navy Yard.

Sea-Going Electric Launch.

Mr. Pears' second electric launch, the "Pilot," is designed as a sea-going pinnace, 26 feet 6 inches by 5 feet 4 inches, and constructed to carry fifteen people. It has been specially built for Mr. Pears by W. S. Sargeant & Co., electric launch builders and engineers, Kew Bridge charging station, Chiswick, and has a mean draught of 18 inches with a displacement of 2¼ tons. The hull is carvel, built of bright mahogany in narrow widths. As in the "Viscountess Bury" and "Pioneer," built and successfully run by the same firm, dead wood aft has been entirely abandoned with the object of obtaining greater efficiency from the propeller, facilitating steering, and reducing surface friction. The "Pilot" is steered by a tiller, and the switch controlling the electrical power is flush with the after deck and within easy reach of the steersman. Lead-lined compartments are arranged under the seats to receive forty accumulators supplied by the Electric Construction Corporation, and are computed to hold sufficient electrical energy with one charge to propel the boat for about eight hours at eight miles per hour. The motor, which is fixed under a centre compartment in the boat, is calculated to develope three-brake h. p. at 700 revolutions per minute. A clear space is left the entire length of the boat, which is quite free from danger, vibration, and the disagreeable odor naturally associated with steam launches.

A New Magneto Call Bell.

The cuts we give herewith show a general view and an interior view of the Gillette magneto, a new instrument which possesses some novel features. Especially is the form of the magnets unusual, it being virtually a double magnetic circuit with consequent interior poles, between which the armature revolves with very slight clearance.

Another unusual feature of the instrument is that the magnets are cast instead of forged, and are made in laminæ, three or four of which are superimposed for the various sizes of magneto. Four are used for the standard instrument, while five, six and eight more are wired together for large testing magnetos. The magnet thus

Fig. 1.—Gillette Magneto Call Bell.

formed does not appear to be very strong, as the magneto works very easily, but in operation the instrument is very satisfactory, operating the signal bells as neatly as could be wished.

This magneto is owned by the Shaver Corporation of New York, and is used in connection with their instruments. The features of cast magnets, and consequent poles, are decidedly novel, at least when combined with a form of magneto of good efficiency.

Fig. 1 shows the exterior of the magneto; Fig. 2 the construction of the interior.

Concerning Alternators.

To the Editor of The Electrical World:

Sir: Will you please give a reply to the following queries in the columns of your valuable paper:

1. Would it be possible to work an electric railway with an alternating converter system, that is, having no connection whatever between the car, which would have a secondary coil under it, and the primary circuit?

2. Has an alternating machine a commutator in the strict sense of the word?

3. If the ends of the primary circuit of an alternator be joined, would it damage a machine in any way?

J. F. J.

[1. It has been proposed to operate an electric railway in the way you mention. We think, however, it would be

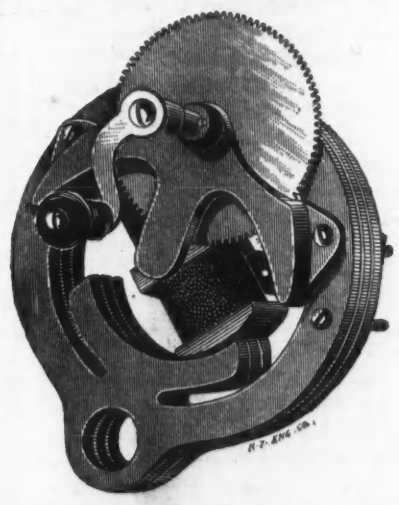


Fig 2.—Exterior of Gillette Magneto.

difficult indeed to transfer any practical amount of power by a method which would place the primary and secondary circuits at such mutual disadvantage. The mechanical difficulties in the way of such arrangement, too, are very formidable.

2. An alterating machine has no commutator for its main circuit, simply smooth collecting rings. It not infrequently happens, however, that a small part of the current is rectified by a commutator placed on the shaft of the machine for the purpose of exciting the field magnets wholly or in part.

3. It depends on the machine. In some cases, constant potential alternators, the armature would probably promptly burn out unless protected by a safety device. For some of the constant current alternators it is claimed that an increase in current under such circumstances is very slight.—Ed. E. W.]

Sewing Carpets by Electricity.

The electric energy is constantly finding new application in our industries, and as each new idea is developed and applied, we are led to ask, when will the limit be reached. An addition to its many uses has recently been made in the ingenious invention by Mr. Franklin Ames, manager of the carpet department of T. Marshall Field & Co.'s wholesale house, at Chicago, of an electric carpet sewing machine.

The machine is mounted upon four wheels of the bycicle pattern, which combine strength with lightness and ease of motion. On the framework, which is suspended from the axles of the wheels, and immediately under the forward axle, is placed a motor—a C. & C. ¼ h. p., 110-volt incandescent—with its resistance box. The rheostat is situate over the rear axle, and under the shelf that supports the sewing machine. The sewing machine and the motor are connected to each other by a belt. A slender upright arm supports the trolleys upon two ¼-inch brass wires that run the entire length of the building, and through which, from the Edison plant that lights a portion of the factory, is supplied the current for running the device. In front of the shelf supporting the sewing machine is a seat for the operator, who controls the action by means of a pedal connecting with the rheostat arm. With this pedal is also connected an upright standard, thus rendering it feasible to dispense with a rider and to operate the machine while standing on the floor. To obviate the necessity of the operator touching the carpet with his hand, a self-feeder is attached in front of the sewing machine.

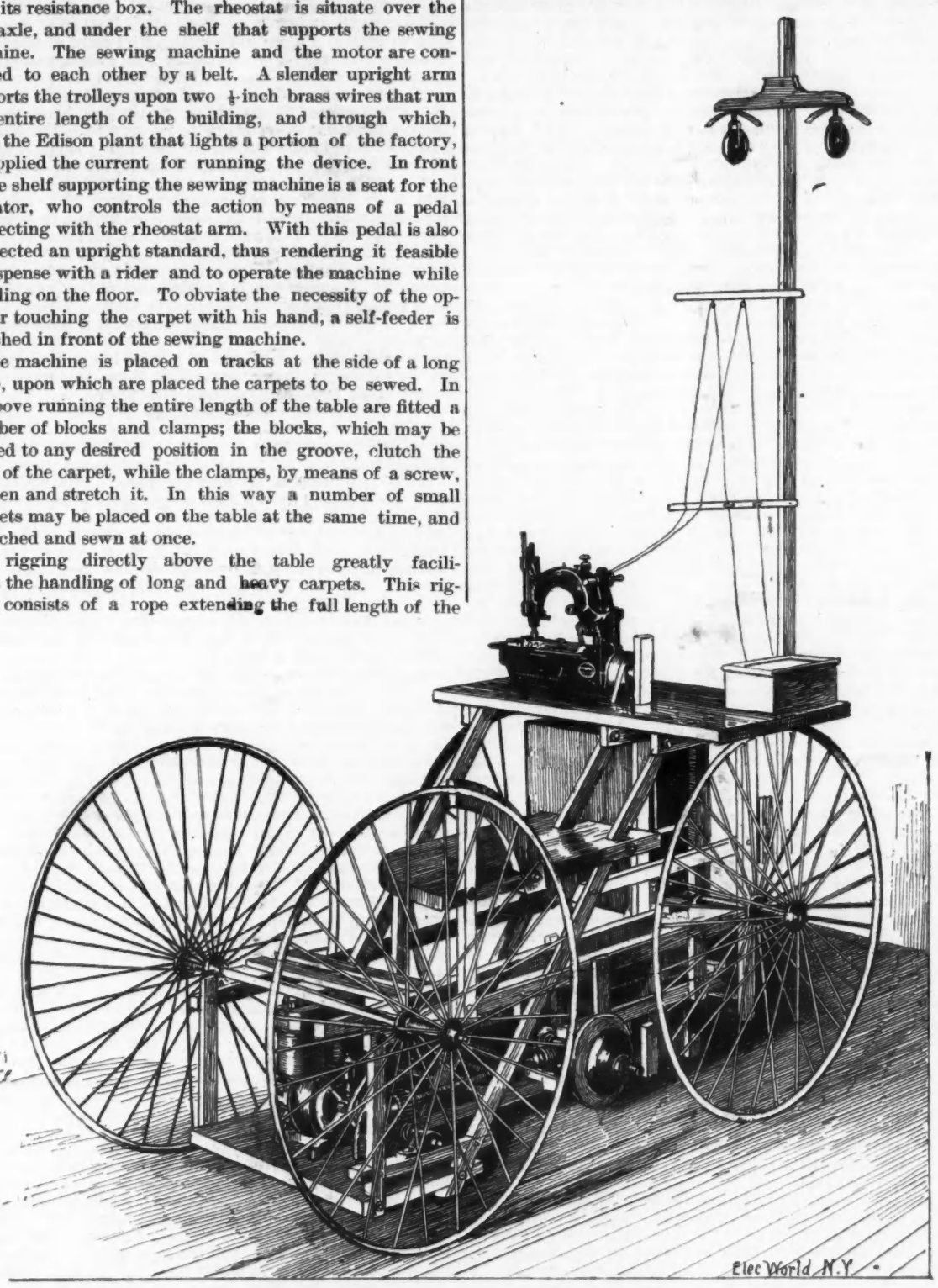
The machine is placed on tracks at the side of a long table, upon which are placed the carpets to be sewed. In a groove running the entire length of the table are fitted a number of blocks and clamps; the blocks, which may be moved to any desired position in the groove, clutch the ends of the carpet, while the clamps, by means of a screw, tighten and stretch it. In this way a number of small carpets may be placed on the table at the same time, and stretched and sewn at once.

A rigging directly above the table greatly facilitates the handling of long and heavy carpets. This rigging consists of a rope extending the full length of the table, and having attached to it at intervals small pendant cords, each with a hook at the end. When it is desired to turn the breadths, these hooks are fastened into the edge of the carpet, the small cords are wound up on the main rope by a windlass, and the carpet raised up on end and held there until another breadth is put in place. The hooks are so arranged that they release themselves when brought into contact with the framework above. so that a few extra turns of the windlass drops the carpet. Basting pins are suspended by cords from a wire overhead, with a small weight on one end of each cord; this weight draws up the pin as soon as it is released from the carpet, until checked by a small wooden stop placed at the proper point on the cord. The pins are extracted by a V-shaped guard placed back of the needle on the machine.

The practical working of the machine is as follows: The carpets are placed on the table and stretched by means of the blocks and clamps, with their edges flush with the edge of the table, and the basting pins put in at intervals of about a yard. The edge of the carpet is caught by the feeder of the sewing machine, which is level with the top of the table, and the whole machine started along the track parallel with the table, by means of the pedal or the upright. The impetus of the machine draws the basting pin with the V-shaped guard, which strikes a wooden guard placed a few inches above the pin. The rate of traveling speed is graduated to the motion of the needle bar, so that no pulling or irregular stitching occurs.

A small boy can start the machine and either ride on it, or walk ahead of it and match and pin the carpet ready for the needle. When it is desired that a different stitch be used, another sewing machine may be adjusted to the carriage with but little trouble.

The immense saving of labor that is accomplished by this machine is apparent when a comparison is made between the amount of work done by it and an ordinary operator. By hand, about 25 yards of carpet can be sewn in a day; by this machine, about eight yards a minute. The inventor proposes so to arrange that two machines may be placed, one following the other, on the same track, and both operated at the same time. Thus ingrain and Brussels carpets may be sewn at the same time, and the amount of work done be doubled. Mr. Ames claims that, with six boys to operate two machines, an amount of work equal to that now accomplished by 300 girls can be turned out. The seam made is superior to any that can be made by hand, excelling in evenness and flatness.



THE AMES CARPET SEWING DEVICE.

Trial of a German Electric Street Car.

Some interesting experiments were tried by the Frankfort commission on the street railroad between Frankfort and Offenbach. The trip was made with a single motor car, carrying a trailer, and the load of persons was from 12 to 20. The weight of the empty wagon of the motor was 4,000 kilograms; the weight of the empty car 2,000 kilograms. Readings were taken every 5 seconds of the volts and ampéres on the car. The ampère and voltage meters were by Hartmann & Braun, and had been recently calibrated. The voltage in the experiment ranged from 200 to 300, and the horse power from about 5 to as high as 35. The current required to start was from 80 to 100 ampères, which on an average after 5 seconds had falleu to between 50 and 60 ampères, and after 10 seconds to between 30 and 40 ampères, while, after the car had settled down to steady running, the demand for current was from 15 to 25 ampères only.

No results for the efficiency of the motor were given in the report of the commission, and neither the speed of the car nor sufficient details of the motor are furnished to give an intelligent basis for comparison with American motors,

Reception of the Edison Electric Illuminating Company, Brooklyn, N. Y.

This company tendered a reception to its patrons and friends on the evenings of April 8 and 10. About 2,500 guests attended the reception, and the brilliant light of the electric lamps found a reflection in the bright spirits of the merry guests. Brooklyn receptions are noted for their good nature and democracy, and this was no exception.

The guests were received by Mr. Ethan Allen Doty, president of the company, who was ably assisted by Mr. W. S. Barstow, assistant superintendent of the plant. Mr. Barstow showed the guests the general office, the test and the meter rooms. In the dynamo and engine rooms the visitors were cared for by Messrs. Baehr and Wolf.

On the second floor is a handsomely equipped test-room. The company has put in one of Queens & Co.'s $500 bridges, and several of the same company's rheostats; they have three galvanometers, and have ordered two more; they use Bergman & Co.'s portable ampère meters and astatic galvanometers, and E. S. Greely combination portable testing outfit. They have a new adjustable resistance which they are arranging for locating possible grounds in the underground system, of which they have 17 miles—they have not as yet been disturbed by any grounds—and one of the Election Company's new 15 h. p. slow-speed motors, which runs a large Harrington drill press with a 2-6 bed plate.

On the main floor there are eight No. 32 dynamos, each feeding 1,500 lamps, and four Ball compound engines of 300 h. p. each. There is also room for 24 dynamos and 12 engines. At present they are running 100 Electrical Consolidated Company's arc lamps, and they have orders for 250 No. 25 Universal arc lamps.

The freight elevator is run by a 15 h. p. C. & C. motor, and the passenger elevator by a 15 h. p. Thomson-Houston motor. Their boilers, four in number, are of Babcock & Wilcox make, of 450 h. p. each. They use nine Worthington pumps to supply the water to the boilers, and their water supply is from a deep well on the premises; this secures them from any possible lack of water. Chief Engineer Theo. Guillandau is in charge of the steam plant. They employ two large and four small Stratton separators, two large and one small Emmory oil fillers, one Spencer damper regulator and a 1 h. p. Thomson-Houston exhaust fan.

A large pin-wheel, constructed by Mr. George Baehr, was placed in the front of the building on the evenings of the exhibition. Over 1,000 persons stood in the streets and admired the spectacle of the rapidly revolving lights. The wheel was on a framework of about 5 feet in diameter, and was composed of sixty 24 c. p. lamps arranged in the colors red, white and blue. In the centre was a large 150 c. p. light, covered with a yellow globe. The effect was striking and beautiful.

Following is a list of the officers and directors: Ethan Allen Doty, president; Edwin Packard, vice-president; Royal C. Peabody, secretary and treasurer; Ethan Allen Doty, Chas. E. Crowell, Eugene Crowell, Darwin R. James, Thos. Adams, Jr., Geo. Foster Peabody, C. N. Hoagland, Samuel Insull, F. S. Hastings, Edwin Packard, Francis R. Upton, Joseph E. Brown, C. J. Field, directors: E. J. Cook, superintendent; W. S. Barstow, assistant superintendent.

Electricity in Wine Vaults.

The offices and champagne vaults of MM. Chandon et Cie, at Épernay, have recently been provided with a very interesting electric light and power installation. The plant comprises three Babcock & Wilcox boilers, three 60-h. p. Bréguet engines, and six dynamos. Three shunt-wound 12-unit Bréguet machines supply the current for the incandescent lighting and storage batteries. Two compound-wound Manchester machines, giving 250 volts and 55 ampères, supply the current for power purposes, and the arc lights are run off a third Manchester dynamo (70 volts × 200 ampères). The incandescent lamps are mostly of 16 c. p., and in the overhead portion of the establishment are fixed in the ordinary manner. In the vaults the wires are bare and of silicium bronze, the lamps being attached to the wires wherever wanted by flexible connectors. The fall of potential in the circuits near the dynamos is limited to two volts; but in those feeding the distant vaults and outhouses a maximum loss of 12 volts is allowed for, the E. M. F. of the dynamos being regulated by varying a resistance in the shunt-circuit. The motors, which are of the Raffard type, with Pacinotti-Gramme armatures, are used for a variety of purposes, such as working lifts, pumps, bottle-rinsing machines, etc. Several champagne establishments are putting in electric light and power plants, owing to the many advantages attaching thereto—such as the reduction of temperature in the wine vaults, and the time saved by employing electric motors in the various occupations of champagne making and bottling. MM. Chandon et Cie, we should add, have nearly 10 miles of underground vaults.

Phenomena of Alternating Current Induction.*

At the 45th meeting of the American Institute of Electrical Engineers held at Columbia College, New York City, April 2, President Seth Low of Columbia College welcomed the Institute with the following address :

Professor Thomson, and gentlemen of the American Institute of Electrical Engineers: It is a very great pleasure to me, as President of Columbia College, to welcome you to our buildings this evening. You remember that at the Philadelphia Exposition of 1876, over the portals of the Egyptian Department was an inscription something to this effect, "Earth's Oldest Nation to her Youngest, Greeting." And so it seems a very fitting thing that the oldest educational institution, certainly of a high order, in New York City, should give this welcome to representatives of the youngest of the sciences. (Applause.) I can assure you that you could go to no place on this Continent where you would receive a happier or more sympathetic or more intelligent welcome; for there is this difference between old Egypt and old Columbia---whereas the greatness of Egypt lies in her past, those of us who are working in Columbia to-day are sanguine with the expectation that what Columbia has been and done in the past is only the earnest of what she will be and do for science, for all education, in the coming time. (Applause.) And that which we think of Columbia we think of you, and that which the electrician has done in the past is only the earnest of what he yet shall do. I rather expect to see the day when this little electrical school here, which has just been started under the auspices of Columbia, may need a building larger than any one we have upon this block for the proper execution of its work, and for the proper care of its collections. And this is to be thought of and remembered by you who come to us from a distance, that whereas some colleges have given their attention to science out of funds specifically donated for that purpose, all that Columbia has done through her school of mines and its many-sided activity, she has done out of the general purse. She has recognized that valuable as letters are, valuable as the classics and philosophy are, science is equally entitled to her care. As men of science I suppose that is all you will ask. Again I welcome you very cordially, Mr. President, and all your colleagues, to Columbia College.

Professor Thomson: Mr. President, ladies and gentlemen and members of the Institute: The subject which we have in hand this evening is more of an experimental character than otherwise, and the object is to bring before the Institute chiefly the results of some actions in relation to alternating currents - actions which are novel and curious, and some of which have never before been shown to the public. Others formed the feature of the exhibit which we made at Paris in the past year. The lecture will deal chiefly with effects producible in closed conductors or closed bands subject to the influence of what we call induction. Every one is familiar with the action produced by passing a current around a bar of iron. If we have a coil surrounding the bar and pass an ordinary continuous current, as it is termed—a current which does not change its direction and does not vary greatly—we get, according to the direction of the current, north and south polarity, respectively developed at the ends of the bar and down the sides to some extent; the neutral region or point of no polarity being in a bar of uniform section and of uniform material about the centre. I may say that the magnetization in putting the current through the coil is almost instantaneous, that is to say, if the magnet is of moderate dimensions and we connect it with a battery we find at once that the ends are north and south in polarity. But if we take such a magnet and surround it with a thick copper tube, or what will answer just as well, a band of copper which makes what we call a closed circuit, then we find that on passing the current into the inner coil, for example, the magnetism does not appear instantaneously at the ends, but we have it coming very lazily and gradually, according to the thickness of this outer envelope of copper. We make what we call a sluggish magnet. We slow up the production of magnetism in the bar. The reason for this is very simple. When we start the current through the inner coil we have at the same moment a reverse or opposing current passing in the outer coil or band which kills or holds back the development of magnetism. After a little while—it may be a second or two in moderate sized magnets, sometimes even more than that—the magnetism has reached about its normal value as though no band or closed circuit surrounded it. We can in this way construct magnets which will not respond to quick impulses of current, but will only respond to impulses lasting for a certain time. These are facts which are pretty well known and sometimes made use of. But let us now consider what would happen if we were to take away the continuous current and substitute what we call an alternating current – a current which goes in one direction during a portion of the time, and reverses, going in the other direction, during another portion of the time. These currents can be made to change their direction many thousand times a second, or we can have them change only a few times a second or have them change every few seconds. The period of rapidity of vibration or alternation can be varied within the widest limits. We find that with the alternating current passed through the coil—removing the envelope —we will get north and south polarity quickly reversed. That is, every time one current moves one way through the coil, north magnetism will appear at one end of the bar and south magnetism at the other, and when it reverses, the magnetism will reverse, and if the current alternates or changes its direction many times a second, these alternations of magnetism will produce what we call an alternating magnetic field outside of the bar. At the same time we will notice that the alternating current is strongly opposed in its passage, by having to reverse the magnetism. That is, it is doing the work of upsetting or turning around the particles of iron in the bar, and it encounters an opposition. The poles will reverse rapidly, as I was saying, and we shall have magnetism developed, but we shall not be able to tell whether it is north or south, if the alternating current is changing its course rapidly; but we shall find, as I said, that the alternating current will not pass as freely through the coil as a continuous current, but will meet with an opposition which we call self-induction, or counter electromotive force. Now, if we put the closed band in place around the coil, we shall find that the magnetic effects are almost wiped out, and further, that the opposition to the passage of the currents through the coil has been almost exterminated, or in other words, has now become transparent to the alternations---the alternations passing freely through, whereas before they were very much hindered. Here then, we have another difference from the action which takes place with continuous currents. Furthermore, we find that if this band is loose or movable, we will get mechanical actions exerted with the band in certain positions. We make use of these principles in what are called re-active coils for alternating currents, an example of which is found here. If we pass through the coil which you see wound upon this structure --- a core made of sheet iron --- if we pass a current through this coil, we find that when this copper piece which forms a band around the coil, is over here away from the coil, a very great opposition is exerted to the passage of the alternating current, and we can use that coil in order to oppose the passage of such currents just as we would put a resistance in circuit with a continuous current to oppose its passage —with this difference, that, wherever we use a resistance in circuit with a continuous current we lose the energy of the current—we waste current; but in the case of the use of such a coil as this—a self-inductive coil—we waste only a small amount of the energy, and are enabled to oppose the passage of the alternating currents or current with great force—cut it down without making the loss real.

If now we wish to remove that opposing influence we can do it with the greatest possible smoothness by simply bringing this closed copper band over the coil, and we can graduate in that way to the nicest degree possible, the force of the alternating current subject to this action. But we would notice in using the apparatus for the purpose mentioned, that when we began to bring this copper over the other coil, an opposition to the movement, we would find a repulsion---a tendency to drive back or remove the copper. In fact, we can easily imagine that with the copper band in the present position, a strong current sent through the terminals of the apparatus would throw it completely over so as to put the full kick, or reaction, in the circuit. This repulsive action is one of the phenomena to which I wish to call attention particularly, this evening. That is, we propose to make this outer band loose, to give it a chance to move, and then study some of the actions mentioned. I brought to the notice of the Institute about three years ago a variety of dispositions of parts, apparatus and devices, showing this repulsive action, and I explained it, but we had not then the opportunity for actually bringing to the notice of the members the instances of the experimental action of the devices. The devices were not at hand, the current was not at hand, and it was not easy to arrange matters. But we will now make up for that, or try to. Now it is hardly worth while this evening to go into a full discussion of the causes of this repulsion. I will state it very briefly, and it will be a repetition of what has already been said before the Institute. It is simply this: The cause of the repulsion is, that in this outer band there will be developed during the reaction of the alternating impulses through the inner or inducing coil, currents which are opposite in direction throughout the major part of their time of existence, to those which produce them. If we could imagine a current passed through this inner coil producing what may be called the theoretical effect purely, there would be no such repulsion. But there comes into play an action which we call the lag, or retardation of the impulse. This action disturbs the opposition of the waves in such a manner as to cause the current produced in the outer band by induction to be opposite in direction to the currents which produce the induction, and opposite currents, according to the laws well known, are repellant, so that if we have two conductors near together in which opposite currents are flowing, we have a repulsive effort exerted. We ought to get—according to theoretical considerations and without introducing any consideration of displacement of currents from the theoretical position—a wave which is just a quarter of the wave length back of the wave which induces it. But in actual practice, if we use as the closed band a conductor of considerable size, and of good conducting material, this wave is not so produced: but it is moved, it is shifted to this position (illustrating); that is, our real wave is not the one-quarter wave displaced, but we find it nearly where I now show it. That is, the current in one coil is in one direction, the current in the other coil is in the opposite direction, and this produces a repulsive effort. I do not propose to go much further into the consideration of that subject, because we have a number of phenomena to bring before you, and that matter has already been discussed before the Institute.

One of the earliest experiments which I have happened to make, as showing somewhat similar actions to that just mentioned, was to take a coil of wire provided with an iron core, and support a disk of copper, in a balanced way, in front of it, keeping it properly balanced by counterpoises. We will carefully adjust the weights so as to get it to about a balanced condition. On passing a continuous current though this coil, we simply magnetize the iron inside the coil. We produce suddenly a north pole at this point, but that sudden production of a north pole induces currents in the disc placed opposite to the pole, which flow in such directions as to produce a north pole, as it were, pointing downward, so that these two north poles repel each other. If, on the other hand, the disc were slightly litted, and I cut off the current, the disc will at once fall; but if I repeat the operation of put ting on the current and taking it off quickly, we find that there is a continued repulsion—or, in other words, the disc is kept at a distance from the core. The disc now is down, and I will put on the current and you see that it rises about half an inch and is now in oscillation. I tried this experiment about five years ago. You see that every time I put on the current there is a repulsion upward of the disc. If, now, I quickly make and break the circuit, you will see that the disc will stand at a distance. It is thrown off the core. We have, in other words, a repulsion produced by continuous currents quickly interrupted. That is due to the fact that the currents induced or set up by the production of a magnetic pole in this core, are attended by the production of other currents in the disc which oppose the action and drive the disc away.

Alternating currents applied to the same conditions may be regarded as very much more rapidly interrupted, and, at the same time, reversed currents, and consequently the magnetic effects are very decided. To show the action with alternation currents, we have only to take a plain copper ring and lay it over the coil as you see (illustrating). We have a source of alternating currents, which are conducted from the lines, and I will close the circuit of the secondary coil, and you see that we have a copper ring resting on a support some distance down the inducing coil. You see this action of repulsion is so considerable as to throw the ring bodily upward. (Applause.) Here the action is exactly what we have before seen, but it is intensified to a wonderful extent. This is a heavy, solid, copper ring, and it is driven, as you see, up into the air quite a height. If I put on the current now for a few moments permanently, I may be able, with care, to balance this ring for an instant in free air. (Applause.) This action of repulsion may be exhibited in very many ways, and as you see, we have one here, in which, instead of holding the ring, it is now supported in the air. But that is not all—two rings are as well supported as one. (Applause.)

The reason for this is quite simple. That ring is affected by the alternating current passing in the inducing coil, and it is affected in such a way as to produce currents that circulate reversely, but are always behind time as respects the inducing currents, so as to be in the opposite direction to these currents at nearly all times. This second ring put under the same conditions is affected in precisely the same way as that ring, and therefore the currents in that ring and in this ring are parallel and in the same direction. Consequently they attract each other instead of repelling. We have then repulsion from this first band and the coil---between this second band and the coil, and because the one is attracted like the other, we have attraction between them so that they hang together, and you can hear the tremor of the alternations. That little rattle you hear indicates simply the time when there is no current. The rings fall apart for a moment and before they can get apart another current is set up which draws them together. (Applause.)

Not only is this repulsive effect manifested, as you see, but if the ring cannot get away from the coil it will undergo what we call the deflective action, or it tends to turn up; besides the action is exerted all around the coil, as you see. I cannot bring that ring over the coil. It is thrown back. Wherever there is any of this magnetic field the repulsion is exerted, and it tends to turn the ring up into the vertical position or plane. The moment I turn it down in this fashion, you see, it is with difficulty that I can pass it over the coil. But if we desired to cut off all this effect, we would only need to cap that coil with a very heavy copper cap, and then the experiments would take on a different character. I cannot lay this copper plate on the coil, as you see. This acts just as the ring does. It is a number of rings, concentric, all of which can have current developed in them, and it is impossible to lay the plate on the coil, for it is driven away. If I were to cut the current off and lay the ring down, and then put on the current in the inducing coil, the copper disc would jump off. That is the case, too, with a silver coin if we get the field strong enough. There is hardly enough force here; but if we get a very powerful field a silver coin will be thrown completely off. This disc we may say exhausts the magnetic field. If I lay it in the field and force it down, I get an effect preventing the passage of magnetic force through it. Here is a lamp, which I light simply by connecting it with a coil and bringing the coil near this coil or pole. Notice when I put the copper plate between. Now we will insert the copper plate—the lamp is extinguished. And the moment we withdraw the plate it lights again and we can graduate its intensity, and as it were turn the lamp up and down, as we do with gas. (Applause.) I call this a shading action—that is the plate shades the magnetic field, or it may be said to be a deflector—it deflects or reflects the magnetic field. It is like a polished plate of silver as compared with light, and we have only to bring it down to the field and we find that the field is diverted and kept from passing through, so that it cannot affect the coil on the upper side which would feed the lamp as if the field were not shaded. We could vary these experiments to a great extent, and I had prepared a few examples of variation, but one of them met with an accident, that was this little floating lamp. This lamp ought to be connected with the coil, but it got broken on the way, and therefore I cannot show the experiment. It was to be placed in this glass vessel full of water, and, as you see it would fall to the bottom. If the circuit had been complete, on putting it into the field, we should not only see the lamp light under water by the sheer effect of the magnetic field traversing the water and producing light in the lamp, but we could also see at the same time the lamp rise and we should have both phenomena---the production of current, demonstrating that the action is due to current developed in the coil, because the currents light the lamp, and we would also have the repulsive action of the current. It is a very pretty experiment, and I am sorry it has been prevented by this accident.

There is another point, however, I cannot leave out in connection with it, namely, that we might have the coil floating in the liquid at a certain height as repelled, and then by diminishing the current here in the inducing coil we would find that instead of having the lamp changing its brilliancy, it would simply settle down and remain of the same brilliancy as before; that is, the repulsive effort would become less. It would drop to a position where the repulsive effort was as much as before, and then the lamp would have the same brilliancy. We have, as it were, an automatic regulation for the lamp by which, no matter how the current varies, we can have a standard illumination. (Applause.)

But, fortunately, I have arranged to show this in a different way. I have a lamp and coil which are placed on the end of a lever. This gets rid of the liquid and gives us a means of balancing the lamp at any brillancy we desire. I there place the little lamp on the lever, put counterpoising weights on the other side, and you see it floats or is balanced at a distance from the coil. But if the inducing current were slightly diminished we would find that the lamp would settle down. In fact, it does always rise and fall a little from the variations on the circuit. I may set that lamp then to burn at a certain brilliancy, and if I wish to vary the brilliancy I take off a weight from the counterpoise and it rises in brilliancy. If I add more weight to this side, I would, of course, diminish the brilliancy, and it might remain balanced under these still new conditions. I take off several of the counterpoise weights. There we have considerable increased brilliancy given, and the lamp will remain so, no matter whether the current fluctuates or not, providing we always have a space between the coils which will enable it to go and come and preserve its proper brilliancy. (Applause.)

It will readily be seen from what we have shown, that we have a mechanical effort exerted tending to drive away this closed conductor. We could easily use that mechanical effort to produce a movement from alternating currents. We can, in fact, use it to produce a rotary motor which turns continuously by simply being supplied with an alternating current. We can use it in the measurement of alternating currents. It has been applied to meters, to

*Address by Professor Elihu Thomson before the American Institute of Electrical Engineers. April 2.

regulators, to motors, and in various ways. But it is not my purpose to go into the details of its application this evening, as we have much other matter which will take up the time. I would simply say that motors have been made which run with considerable power, and which appear to have a fair efficiency, and are at the same time self-starting —based on the principle of simply closing a circuit when it is in the proper relation to the alternating current coil, allowing it to be repelled to a distance away, then closing another circuit, and so on, making what is called the transformer type of alternating current motor. Now, we have come to another department of the subject growing out of the experiments which I showed in this ring and in the other ring. I have shown that if one ring be placed over the coil, and another ring be brought under it, there is a tendency to attraction. An attraction is exerted which brings the one ring directly over the other ring. Evidently we could use this principle also as a source of motion, because these two parallel currents may be made to attract each other, but the limit of the movement is at once found. When the rings are parallel substantially, they cannot move farther they cannot get any nearer than when they touch. But we can so modify these effects as to produce a continuous rotation, and I will show a few instances of that. I may take a copper disc mounted on pivots, and this copper ring; I place the ring here over the coil, and the pivoted disc alongside. Perhaps I can work it at an angle so that the effect may be better seen.

It occurs with great vigor in this position; and the revolutions become very rapid. I have only then to put this closed circuit ring over the other or inducing coil, modify the field by placing it there, and then put this rotating disc in front of the magnet there, above or below the ring—it doesn't matter which. If I put it above I get the effect of rotation, and if I put it below I get the same effects precisely—either one side or the other of this ring may go, and the disc is set into rotation. This disc is in essence nothing more than a series of rings which can be thrown into parallelism or attempted parallelism with the first ring or band, and then finding new material to one side, and which has not got into parallelism, a renewal of the action goes on and results in rotation of the disc. But I wish to call attention to one fact, that if I put the ring exactly concentric with the inducing coil I do not get such effects; I must displace it laterally. No movement occurs if I place it exactly concentric—it is difficult to find that point in this case—and if I err ever so little the disc begins to revolve. If I carry it over the other side the disc revolves in the other direction. The effect is very easily obtained also by substituting for the ring a plate of copper. That is, the plate is virtually a ring or set of rings as well as the disc, and if I place this sheet of copper in front of the pole the actions are the same as before, and if I wish to reverse the action I place it on the other side. In fact, any closed circuit that I make or bring into position in this field will so modify the field that the disc will be set in motion. It is not necessary at all that we use a copper disc. We may use an iron disc, but then we shall notice something quite different. The iron disc is vigorously attracted and we have to be careful not to let it be pulled down. You see the iron disc is now in rapid rotation in the same way, and is reversed in the same manner as with the copper disc, but there is a real difference between iron and copper in this connection, as we will see. I will put this copper disc here virtually to the ring. Now it has come to rest in a balanced position. It does not rotate, but it does rotate if I put it down in this position, parallel with the field modifying ring. Let us take the iron instead and there is no trouble about the iron in the vertical position. Hence you see we have really a difference after all. The copper and iron work alike, but they do not work alike altogether. Now the fact is that we have come to deal with two different phenomena in these cases. This copper works when it is parallel with the plate or closed ring, because its action depends on the circulation of currents in the plane of the disc, which cause it to rotate. The iron will work just as well one way as the other way, and at all angles, because it does not depend for its action upon currents that are set up in the iron, but simply on the property which iron has of not changing its magnetism until it is forced to. That is, it has the property sometimes called by the term magnetic friction—magnetic lag, or the modern term, "hysteresis." It is not exactly like air in its magnetic capacity. It has, in other words, a tendency to remain magnetized, as it was, and so resists change when we place it in a field which forces it to change. We place it in front of a pole which does not remain north or south, but which is constantly changing from north and south, and at the rate of about 250 times a second of change. Hence if the lower part of the iron disc gets magnetized north and the top becomes south, instantly, if this disc cannot accept the new condition of reversed poles from the core below with great readiness, it is evident that the polar part of the disc wants to leave, and the new portion, which has not been given a magnetic polarity, will tend to be brought into play instead. But when we place the disc over the inducing coil or core in this manner in a vertical plane, it simply oscillates a little and comes to rest. It does not know which way to turn. It might just as well go out one way as the other, but now this ring or closed circuit decides the question. The copper plate decides that the iron shall move in one certain direction. Now, we may analyze this action a little on the blackboard, because here we shall find a key to all these actions. We will take our magnetic pole which is changing north and south, and we will take our sheet of copper partly covering that magnetic pole. Take the disc of copper and place it above. Now, if this pole is north, this lower edge of the disc will be south. If this pole is south, then this lower edge of the disc will be made north. All above the lower part will become of the other polarity—if south, north up here; if north, south up here. But when we put this copper plate or ring into place, it is inductively acted upon by the pole so as to produce currents in its plane. These currents are not extinguished when the inducing currents are, but are retained for a moment after the former cease and are ready to reverse. Consequently if the current has produced a certain polarity here in the lower edge of the iron disc, that current in the plate of copper will attract the magnetism, as it were, and pull it toward its own center. The polarity, if south o north in the disc, will be drawn here toward this plate o ring which tends to retain the current which was induce in it. The under side of this ring or plate will be opposit in polarity to that which induces the current, but th upper side will be of the same polarity as the pole of inducing coil just after the impulse of current in the inducing coil is ready to reverse. When we use a copper disc and lay it down horizontally, then we have two sets of parallel currents, rings slipping one over the other, and a renewal of the effect continually with every alternation.

I could amplify the disc experiments to a very great extent. Two copper discs may be taken. Now, if my explanation is right, it does not really matter which of these is moved. In other words, if currents are set up in this disc, which are attracted by parallel currents in the other disc, both should move continuously in a direction to bring these currents together or toward each other. I therefore put this copper disc over the pole on that side, and this other one on this side, and you will see that both of them are set in rotation. (Illustrating.)

We are really shading the pole with two discs, and they are revolving in opposite directions. The copper disc may be affected by the iron disc and both revolve. (Illustrating.) But if I modify the experiment so as to place this copper disc over the pole in this vertical position, and this iron disc in the horizontal position, there is no effect on either disc, but if I take the iron and put it in the vertical position, and the copper horizontal, both of them will revolve after I get the right conditions. My iron disc is not very well balanced. (Illustrating.) Both discs you see are revolving, but now the iron disc is at right angles to the copper. We could, of course, by properly arranging matters, set a whole mass of discs in operation in different directions according to the conditions which were chosen. This alternating magnetic field extends away out into the air here, and we could fill it full of discs provided we did not cut off the field, and they would all be set in motion accordingly.

There are some other curious effects, however, produced in extending this disc experiment. Here is an ordinary steel file. If I take this copper disc and lay the steel file across the magnetic pole in this manner, and then hold the copper disc near it, we see that the steel file has the property of setting the disc in motion. If I take two discs and place them over the steel file at the opposite ends, you will find that they will revolve as though they were geared together—one out this way and one out the other way. And as above, an iron disc placed in this vertical position over the file will revolve, or we may place it in the horizontal position and it revolves. Here the effect is the magnetic effect, not the current effect, and with the two iron discs the rotation of both of them is produced, as you see, whether they lie in that plane or in any plane in respect to the file. (Applause.)

It is not even necessary to get this rotary action that we should use the file. We can take the copper disc, place it over the pole flat-wise, and then simply bring another core of soft iron over the pole, but displace it a little from the axis of the other core. And you see, we get vigorous rotation. In fact this is a principle I have used in making, with some success, a small alternating motor. By simply displacing the poles and putting a copper circuit between, the rotation may be made continuous, and by multiplying the number of poles a considerable exertion may be obtained.

Cast iron behaves like steel in this connection. Here we have a curious instance of a cast-iron ring on which I have simply wound a little closed coil. I place this ring over the alternating pole, say, in this manner, symmetrically. I get no tendency to rotation in this disc. I have placed the closed coil at the opposite diameter from the inducing pole. If I make the placing unsymmetrical, however, so that the coil is on one side, then, you see, I get rotation in the concentric iron disc, but not very brisk. I simply put the iron disk in position, and find that the magnetism, in traveling around this ring, turns the disc, while this portion of the ring, which is covered with a little closed coil, prevents the magnetism from creeping around the ring in such direction that we do not get the opposing or balancing effect which would stop the disc. The closure of circuit of this coil simply prevents the propagation, as it were, of the waves of magnetism from the alternating pole in this direction at the same rate that they go in the other direction around the cast-iron ring. Consequently we have a rotation of the disc in this direction, showing us in a different way what we were getting with the file. We were getting waves of magnetism which passed out along the file in each direction, and which took some time so to pass, that is by beginning in the middle of the file at the pole and moving out and only reaching the end after a little interval; the reason being that the file, although it is not surrounded by closed circuits, as is the case with the cast iron ring, has another property which I mentioned before—magnetic friction which opposes quick changes of the magnetism. It uses up force to effect such a change. It warms, not by induced current, but by the effort of the field to turn the molecules first one way and then the other in producing opposite polarities. The actual result of that action is as follows: We will consider the instance of the file. That, we will suppose, is laid across the pole. When the pole changes to north the north in the file splits, as it were, and moves outward, while the center becomes south, and the two norths travel out along the file oppositely, and being north-poled they of course are surrounded by magnetic lines, and in fact are moving consequent poles for the time being.

Now we may put here a disc of copper or iron, and these magnetic poles or lines are sweeping along the file. They act like magnetic brushes that are brushing the disc around, and they disappear in closing themselves up or neutralizing, as it were, at the ends. That is, when a pole in traveling goes so close to the end of the file, it is so near an opposite pole as to neutralize it, at which moment the action ceases so far as those lines are concerned, and a new set are sent out to travel along, and this goes on continuously at every wave of alternating current.

We have an example here of a little alternating motor of a very small type which is built up on the principles we have been showing, only we have a different form of magnet. In this case I have a circular core. That is, I have a ring of iron which would return on itself; but I have cut a slot through it of about a quarter of an inch in width. On the sides of the slot I have placed copper circuits which are closed—closed bands in which circuits can be produced. But I have off-set them so that there are more on one side than the other—so that the poles are shaded on one side and not on the ether. If I introduce a copper disc into the slot here and put on the current, we will see that we have an alternating motor produced (illustrating) and it exerts some power. This machine, however, I use for another purpose. I have two coins, and one of them I lay on my hand in this fashion, just below the slot, and it is drawn in and thrown violently out, upward through the slot. In other words, the silver coin tends to do what this disc did—continually move up through the slot. But this disc may be regarded as a lot of coins stuck together and consequently we have continuous movement. Here we have only one disc. But we will try another coin. With that we get no such effect. It is a counterfeit. (Laughter and applause.) But listen (ringing the coins). There is not very much difference in the ring. One might easily be deceived. But the machine knows the difference. The silver of the genuine coin is a good conductor. Silver, even with an alloy of a baser metal, like copper, retains a large portion of its original conductivity. Consequently the currents induced in the silver are much more considerable than can be induced in this base coin, which is not so good a conductor. Anything that imitates silver does not come anywhere near it in conductivity, especially if it is expected to weigh as much as silver, in which case lead is generally one of the constituents; and this alloyed with other metals is still worse. I keep these coins in separate pockets, you see. (Laughter.)

Now, there are some other curious effects of rotation which are rather modifications of what has already been shown, but they are certainly curious. They are explained on the same grounds which explain the rotations of the disc, and to which I have referred. But from their uniqueness they are perhaps more interesting in some ways. They are certainly in a popular sense more interesting, because the actions are somewhat unexpected. Here is a hollow copper ball. I place a brass plate over the alternating pole, and it projects not two-thirds over. I place the copper ball on the plate, and you see the copper ball at once spins. Placing it on the other side, it spins in the other direction. It is behaving just like a copper disc placed over another disc. Here is a little one, a smaller ball (applause) the spinning-top of the future.

You have heard the old rhyme about the dish running away with the spoon. I am going to have it modified in this way. I have a brass dish here which will run away with a cup. We have the same spinning-top effect. It is not at all necessary that we use a plate for that purpose. I showed you some time since the equivalency of a plate with a ring, and I shall now merely make a momentary substitution of this copper ring with a mica sheet, to rest the bodies on, and you will find that the copper ball spins in that ring as though placed on the plate. But a more surprising effect is yet to come. I shall have to put on a guard rail to the apparatus in this case to prevent the ball running away from us. I have two glass pins inserted in a plate which partly shades the pole and I will lay the copper ball against these pins. The ball rotates over this way and actually overcomes the friction of its lower side on the plate. It has to turn on a horizontal axis and its equator rubs the shielding plate. The action is very vigorous, as you see.

One of the interesting modifications of this experiment we will attempt to show. It is somewhat analogous to the experiment of the lamp immersed in water. I put over the core a vase of water. We have the alternating current on. But you see there is no action of the ball. It requires that we place underneath, a shading disc. Now, we have a rotation of the ball in the water. This may become quite vigorous, and we obtain extra vigor by putting a copper ring in the water. This is a pretty modification of the other experiments, and has this advantage, that the ball keeps cool. In the other case the ball gets warm. The currents are so energetic that they actually warm the ball. Now the ball is rotating right in the copper dish, and sometimes when we get sufficiently vigorous action the dish and the ball both are set in vigorous rotation. Now, the dish is going about or turning. We might fill the water with small balls. I have had three of them in operation at one time, rotating in different ways.

One or two more experiments in this direction. I have mounted a somewhat different arrangement. I have a little wheel or rim of copper with an iron interior. That is, it is like the armature of a dynamo wound with wire or covered with a conducting envelope. We place a wedge of iron on the pole, and then I shall bring this one to one side or the other of the edge of the wedge. You probably cannot see the action, but you will perhaps take my word for it, that the little wheel is revolving very rapidly, and if I put it on the other side it revolves in the other direction as though a jet of something were shooting off that edge. This jet is nothing more than the traveling system of magnetic lines. You are all familiar with the gyroscope—the instrument which you had generally to spin by winding a cord and pulling it off the shaft. Here is a gyroscope which is the gyroscope of the future. You do not require a string or battery except the alternating current field. You do not require any connection with the instrument. I put a center for it to move on in the magnetic pole. Already the little disc is rapidly revolving, and I will let go of it in the ordinary way of the gyroscope, and you will see it turns about. It will get up to quite a speed in a little while, and then you will see that the gyroscopic action is very beautifully manifested. Now the thing that causes rotation in this case is the little inclined frame holding the wheel. It does not lie, as in an ordinary gyroscope, horizontally, but it lies in an inclined position. The wheel is simply a copper wheel with a laminated iron core supporting the copper ring. It is getting up a very high speed now, and the gyratory rotation is consequently slow—one of the phenomena of the gyroscope. (Applause.) To reverse the rotation I would do as with any gyroscope—simply move the weight so as to bring the balance outward instead of inward, and then the rotation would be opposite in direction. Now the rotation is in the opposite way. I have overset the gyroscope by putting the weight out from the pivot so as to overbalance it.

Dr. GEYER: Have you ever taken the weight off altogether?

Prof. THOMSON: I haven't tried that, but it is possible, I think, with very high speeds. But if I take the weight off the copper frame it does not retain its angular position. I need the weight to hold it in place. I must have the angle of the frame preserved. The deflective action comes into play to turn this circuit to right angles. With this experimental illustration, we see that a curious series of phenomena are manifested by alternating magnetic fields.

There is but one other statement I wish to make before closing, and that is as to the marvelous capacity for the transfer of energy which an induction coil possesses. If we could imagine an induction coil, that is, a coil composed of a winding, which acts to produce currents in another winding, carried to a very low temperature, we could have the resistance of the copper to the passage of the current almost obliterated. Then we should find that we could load the copper coils with an enormous amount of current

They could probably be made of tubes, and refrigerating fluids passed through them. We would find the actual amount of energy which could be conveyed from one circuit to another by a moderate sized coil and with a core of very moderate dimensions, that is, with an iron core and a magnetic circuit of very moderate dimension, would be counted by thousands of horse power. Our experience has taught us that even under ordinary conditions it is no unusual thing to transfer 30 or 40 h. p. through a magnetic core which a man can easily lift, and do it efficiently and well. The iron part of the apparatus has very little to do with the action. We could take it out altogether if we could refrigerate our coils and wind the two coils close together. The induction coil is probably one of the most striking examples, or proofs we may say, of the fact that the actual mode of transference of energy along an electric wire is not through the copper of the wire; it is through the medium outside of the wire. The modern views of electricians, gradually becoming more and more credited, is that the wire is merely the core of a set of disturbances which are really propagated around it. That is (illustrating) if we have a wire conductor carrying a varying current, that current is merely an incident of something which is going on all around in the space surrounding the wire—in the ether—in the medium which surrounds all bodies and which fills all space. Now it is manifest, if this be true, if the varying current is merely an incident of this propagation of energy in that medium, put another wire there and you ought to have a current as an incident of the propagation, and if you coil those wires up together so as to make a coil in which two conductors lie side by side, as in an induction coil, if the propagation of energy is thousands of horse power and this current in the centre an incident of that propagation, thousands of horse power may be represented by the currents of which this is an incident, too—or, in other words, the two circuits are in the same relation exactly to that thing which represents or carries energy. The primary circuit and the secondary circuit are really immersed in the thing which is conveying electrical energy, the wire merely serving as a centre around which the energy shall be propagated. I thank you for your attention this evening; and, if I haven't been very scientific, I hope I have shown some things which have been of some little interest. (Applause.)

Board of Electrical Control.

The meeting of the Board of Electrical Control, on the 8th inst., was opened by a discussion of the destruction of insulation in the conduits by excessive heat from the steam pipes. The leakage, it was stated, was caused by breaks in the steam pipes. The electric light companies showed a desire to have their wire tests reduced, but the Board dissented, and a resolution was passed directing the expert of the Board to present a report on the subject, with such additional data from other experts as he might think fit. The engineer of the Board was directed to notify the Steam Heating Company of the location and extent of leakages, and to request them to take immediate steps for the stoppage of the same.

Mayor Grant asked if there was any one present who was officially empowered by the Standard Company to accept the contract for laying down the proposed new subways. Mr. G. L. Hardy said he could not speak officially, but he explained that owing to a misunderstanding as to the date of the meeting of the Board, Mr. Peckham had gone to Albany.

The Mayor criticised very sharply the action that had been taken by the Standard Company. He said he was prepared to give out the contract for laying the subways; he would like to know whether the Standard Company intended to go on with the matter or not. Mr. Hardy said he did not think they did. The Mayor said that the Board had acted in good faith throughout, and it appeared to him that it was rather late for the Standard Company to assume such an attitude and to have no counsel present. "This may be a very nice way of doing things," said the Mayor; "but it doesn't strike me as being a very nice way to treat an official Board. If the Standard Company want to drop the matter, I think the least they can do is to send us a letter declaring that intention."

Mr. Lauterbach said he was surprised at Mr. Peckham's absence, but thought he might say, without exceeding his authority, that the Standard Company had no intention of going on with the subway contract. This, of course, left the Consolidated Company in a position to comply with the mandates of the board and go on with the work, and this they were prepared to do diligently and well.

"The first thing, then," said the Mayor, "will be to annul the resolution of February 17, awarding the contract of the construction of the electric light and power subways to the Standard Company." This resolution was then rescinded.

Mr. Lauterbach: I am instructed to say that the most diligent co-operation will be given by our company to assist the Board, and to do all the work they may wish to have done. Of course we have been put back considerably by the delay consequent on the decision of the General Term, but since the contract has not been entered into by the Standard Company we shall do the best we can. I hope, too, we shall have the assistance of the electric light companies.

A resolution was then passed directing the Consolidated Company to proceed immediately to lay subways in streets where new pavements were going down; and the electric light companies were ordered to put in their applications for space before the 10th, so that the Subway Company might make their arrangements accordingly. They were further instructed to speak for only just the space they intended to occupy. It was also directed that the companies should give bonds for the use of the subways in accordance with the rules and regulations of the Board.

Some Tests of Anti-Friction Metals.

Manufacturers of electrical apparatus will be interested to know that Prof. Torrey recently made an extended series of tests to ascertain the qualities of the best known anti-friction metals when subjected to work such as is in accordance with everyday practice. The tests were made for the purpose of ascertaining the comparative merits of the best known metals of this character under the severest conditions. Some 30 or 40 metals were tested, and from these three or four were selected as being the best, and which were then subjected to an extreme comparative test in order to ascertain without doubt which was the best for the purpose. In each case in the final test the best oil was used as a lubricant, extreme care was exercised in fitting the bearings and journals, and an accurate record was taken as the test progressed. With deoxidized genuine Babbitt running 15 minutes, with a pressure of 1,000 pounds per square inch, the metal wore considerably and flowed at the side. With Hoyt's genuine Babbitt metal for a run of five minutes, and 1,000 pounds per square inch, the result was in a measure similar to the above. With Post's zero metal for a run of 10 minutes, with 1,200 pounds to the square inch, the metal showed extreme wear and the box was practically destroyed. With Magnolia anti friction metal, under a test of 50 minutes, with 1,200 pounds to the square inch, this being followed 25 minutes with 1,425 pounds to the square inch, the bearing showed only in a slight degree any evidence of the extreme duty it had to perform. In the six tests the diameter of the shaft was 5 inches, the velocity of the rubbing surface was 2,033 feet per minute, and the revolutions of the shaft per minute were 1,600. The load placed upon the metals varied as given above. The Magnolia metal showed that under the most severe duty, running at an excessive speed and far overloaded, it maintained its original form and showed no evidence of undue wear or excessive heating. It will be noted that this test is at least four times that required by ocean steamers or by government war ships, both of which cases may be taken as showing the extreme practice, or, in other words, a metal which will stand the test above given has a factor of safety of at least four when compared with ordinary practice. This metal is made by the Magnolia Anti-Friction Metal Company.

Preparing for the Cape May Meeting.

A meeting of the Executive Committee of the National Electric Light Association was held at the Electric Club in this city on April 14. Messrs. Marsden J. Perry, C. R. Huntley, Jas. English, A. F. Mason, M. J. Francisco, John A Seely. and Allen V. Garratt were present. The resignation was received and accepted of Mr. M. D. Law, who has left for Denver. Mr. C. H. Wilmerding, of the Chicago Arc Light and Power Company, was elected in his place. Mr. R. W. Ryan was appointed official stenographer for the next convention. As the association must move May 1, a committee was appointed to select new offices. Messrs. F. T. Walton, A. J. DeCamp, J. J. Burleigh, John A. Seely and the secretary were appointed an entertainment committee, with power to fix the date of the semi-annual meeting. Messrs. Lockwood, of Detroit; Wilmerding, of Chicago, and Mason, of Boston, are to secure suitable papers for the Cape May convention. Mr. Allan V. Garratt resigned his position as secretary and treasurer, to take effect June 15, and Mr. Allan R. Foote was appointed in his stead.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York. April 19, 1890.

T. Marquand, the manager of the Roxite Insulating Company, Harlem, N. Y., has a very fine substitute for hard rubber. They have a new and improved incandescent lamp socket, made entirely of this material, with contacts set in the material.

Mr. Geo. B. Prescott, Jr., will assume, on the 15th of the present month, the management of the Insulated Wire and Cable Department of A. G. Day, 16 Dey St. His resignation, tendered in March, was accepted by the Electrical Accumulator Company on the 11th of this month.

H. W. Putnam, of H. W. Putnam & Co., 26 Church street, New York, has secured a franchise to light Frenchtown, N. J., for five years; also contracts for commercial lighting for nearly 800 lamps It is to be a direct lighting system. He has secured contracts for lighting other towns, also.

McCreery & Prendergast, 986 Sixth avenue, New York city, construct, repair and install electric and mechanical bells, annunciators, burglar alarms and all kinds of household and electrical specialties. They always carry a complete stock of electrical supplies; they wire for the electric light, and have made a reputation in the trade. The vast quantities of work they have done in the past few years stand in monuments of brown stone dwellings in our finest uptown streets.

The Tucker Electrical Construction Company, 14 to 20 Whitehall street, New York, are said to be doing a large construction business in this section in connection with their agency for the Mather dynamos. They are installing for the Thomson-Houston Company 86 arcs and 150 incandescent of the Mather, run by two Buckeye engines of 60 h. p. each, and a 1,000-lamp plant in the new Jefferson Clubhouse, Brooklyn. They are using in all this work the best Grimshaw rubber white core wire run in interior conduits. They have many other contracts just being begun.

Mr. E. W. Carritt, who devised and superintended the installation of the long-distance telephones at the Lenox Lyceum electrical exhibition, is a walking encyclopedia for the ready reference of all the telephone companies represented at 18 Cortlandt street. He has a phenominal memory for electrical business, and has retained the name and number of every telephone subscriber in New York City. He knows the route of every conduit or subway, the number of ducts in each, the amount of cables and wires in each, and their service, whether telephone or electric light, and can locate every empty duct in any part of the conduit system in the city.

Mr. T. McCoubrey, of the Crocker-Wheeler Motor, is much pleased because of the success which is attending his connection with this company. Among the recent orders is one for a theatre cool air invigorator plant for the Star Theatre, which will remain open all summer. The owners intend by the use of these invigorators to keep their patrons cool. In reply to the query, "How will they do this?" Mr. McCoubrey said: "Simply enough. They will run a Sturtevant blower by means of one of our 7½ h. p. electric motors, and force the air through a chamber 12 × 12 × 9 filled with ice. After this the air is evenly distributed through ventilators in the aisles of the auditorium."

Lewisohn Brothers, 81 and 83 Fulton street, are sole agents for Tamarack Osceola Copper Manufacturing Company, of Dollar Bay, Mich. As the factory of this company is built on the shore of Lake Superior, right in the midst of the largest copper mining district in the world, and as the company own their own mines, the inference is obvious that they can furnish wire, rod, bar and ingot copper, and especially bare copper wire, at the lowest possible rates. They make a specialty of hard drawn copper wire for telephone and electric railway use, and soft wire for all electrical purposes. With their facilities Lewisohn Bros. can ship in immediate orders any desired quantity or quality of copper.

Dr. S. M. Plush, superintendent of the Philadelphia Telephone Exchange, recently told Mr. W. A. Childs of two blind operators in his employ. The very interesting sight of these two sightless operators manipulating the switches was witnessed by Mr. Childs in person. Dr. Plush explained that he had been addressed by a young lady with the request that he employ her blind brother. The feasibility of the plan was questioned, but the young lady, with Dr. Plush's permission, drew a diagram of the switchboard, which she took home. From this she so instructed her blind brother that he became competent to fill the position. It is interesting to note that Dr. Plush has since received applications from more than two hundred blind persons for similar positions.

Mr. W. A. Childs, of the Law Telephone Company, and manufacturer of the Law battery, which is gaining such popularity, is improving the system of switchboards for the Law Telephone system. He has made some great improvements in their batteries. He aims to make this battery perfectly air-tight when it is set up, and does so by putting a rubber cushion over the zinc rod near the top of the battery cover. A brass rod is threaded and set in the top of the zinc rod, and by the use of a small zinc nut this rubber cushion and rod are drawn into a hole in the cover. This tightens the rubber over the rod, and presses against the sides of the hole in the cover, thus avoiding any possibility of air or moisture passing through. Then, by the use of lugs on the fibrous composition cover and a rubber washer the cover is set so tightly upon the battery jar as to avoid the possibility of acid, moisture, or air passing in or out of the battery when once set up, avoiding evaporation and decomposition. The other added improvements in the cylinder carbon cup give a very complete battery, and one that they claim will never polarize. If by accidental close circuit the battery should become discharged, by the simple renewal of salts and water the battery is as good as new.

The National Electrical Manufacturing Company, 29 Murray street, successors to the electrical department of the New Haven Clock Company, has been organized under the laws of New Jersey. The business will continue under the present manager, J. G. Noyes, who has successfully introduced N. H. Co.'s goods. The directorate of the company is composed of New Yorkers prominent in financial and commercial circles, and has a large amount of paid in capital. The company will take over all the machinery, tools, fixtures, etc., used the electrical department of the New Haven Clock Company. Under their arrangement they will be enabled to use all the New Haven Clock Company's clock machinery, their foundry, wood-case shops, etc., and in addition will add many new labor-saving machines. This company will manufacture all kinds of wire for outdoor and indoor use. It is their intention to place their wires on the market at once. Their facilities will be extensive. They will also control the microphone open circuit and Crowdus dry batteries, the Porter Electric Messenger Company, and a number of other patented devices, their iron and wood box bells, annunciators, burglar alarms, New Haven improved Morse telegraph key and sounders, as well as relays. Western Union and other telegraph instruments, and a full line of district messenger supplies. It is the intention of the new company to give great attention to details, and to go into every line of electrical manufacture.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, April 19, 1890.

Erie Telephone Stock was sold last week for $40, the highest reached since 1884.

Mr. C. L. Edgar, Superintendent Edison Electric Illuminating Company, this city, has returned from his European trip.

The plant originally installed for I. Prouty & Co., Spencer Mass., with 300 lights, is now increased to 1,200 by recent additions.

Hartford, Conn.—The Graphophone plant, controlled by a syndicate which sends its product to Europe, is to be removed to Orange, N. J.

The Standard Electric Company, of Vermont, report following sales: To C. J. Brush, Brooklyn, Conn., 200 light dynamo, Armington & Sims engine.

The Edison Phonograph Toy Company have just received a supply of dolls and are now ready to do business. They expect from now on to be able to fill all orders.

The New England Mutual and Electric Insurance Company, in which Captain Brophy and Mr. Barton are interested, will in all probability be ready for business about May 1.

Cable repairing.—Three linemen in charge of the division of Buzzard's Bay have made all needed repairs on the lines of the French transatlantic cable between North Eastham and Buzzard's Bay.

Providence.—The Russell Electrical Manufacturing Company have now over 20,000 feet of their mast arms in use in 35 cities and towns. They are also doing a good business with their porcelain insulated hoods.

Dover, N. H.—The Cocheco Manufacturing Company has decided to dispense with gas for lighting purposes and has made a contract for an isolated electric plant, incandescent system, with the Thomson-Houston Company.

Quicken the Service.—A petition circulated in Brookline, Roxbury and Brighton, asking the aldermen of Boston to increase the speed of the electric cars, received in a few hours over 400 signatures of prominent business men.

Middletown, Conn.—At a special meeting of the stockholders of the Thomson-Houston Company, held in this city Saturday last, it was voted to increase the capital stock $3,000,000, making the total capital stock outstanding $11,500,000.

Manchester, Conn.—The Mather Electric Company will enlarge its factory to about double its present capacity. The new building will be erected across the end of the present structure, at right angles with it. It will be 250x60 feet, and three stories high.

The Connecticut Motor Company, through R. P. Smith, its New England representative, reports the following sales: A 1 h. p. motor, a 3 h. p. motor, and a 25 h. p. motor, to Boston parties We understand that this is the only 25 h. p. motor in use in Boston.

The committee on electric wires, to whom was referred the petition of the Suburban Light and Power Company for locations of poles within the city limits, particularly in South Boston, Roxbury, Dorchester and West Roxbury, reported an order granting certain locations.

Mr. F. B. Pettingell, of Pettingell, Andrews & Co., returned from Europe on Monday. He reports a pleasant trip and great improvement in health. The increasing business of this company has necessitated the enlargement of their present quarters to double the amount of room formerly occupied by them,

Lynn, Mass.—The Thomson-Houston Electric Company have contracted for a special high-pressure Armington & Sim's engine 450 h. p., 240 revolutions per minute, with two drive wheels belted direct to the dynamos without counter shafting. It is to be used for special work in testing a class of dynamos of extra large size now being constructed.

Athol, Mass.—It has been demonstrated that there is not enough available unused power at any one place on the river to furnish the 150 h. p. necessary for the electric road. Negotiations are now going on between the electric road people and the managers of the Electric Light Company for the purpose of establishing a steam plant to run the works of both companies.

The Tropical American Telephone Company have just issued a new forty-page circular for the better information of the general public, setting forth its exclusive rights, patents and concessions in foreign countries. This company is now receiving large orders from South and Central America and the West Indies. Mr. J. H. Howard, their popular general manager, is to be congratulated, as it has been a persistent struggle for years to gain a foothold. In this connection we should note that W. R. Grace &

Co., who have large concessions from the Government of Peru covering railroad, telegraph, telephone and nitrate interests, have been appointed exclusive agents for the West coast of South America for the Tropical Company.

Newington, Mass.—The River and Rail Electric Company, with a capital stock of $1,000,000, has been organized by Henry M. Robbins at Newington, and it is thought that an immense plant will be established here. New York and New Britain capitalists are principally interested in the scheme, and it is hoped that the establishment of the plant will add greatly to Newington's prosperity.

Lynn, Mass.—W. R. McLain, one of the most popular foreman of car shops of the Thomson-Houston Company, has resigned to accept a position as master mechanic with a street railway company, at Des Moines, Ia. The Newton Street Railway Company are raidly relaying the rails between West Newton and Waltham. It is expected that the road will be fully equipped with the Thomson-Houston system by July 1.

Suit Against the Commercial Telegram Company.—Mr. Thomas Savage, of this city, counsel for J. W. Mackay, entered a suit yesterday, in the Superior Court for Suffolk County, to recover a judgment of $287,313, which was accorded to Mr. Mackay by the Superior Court of New York in a suit brought by him against the Commercial Telegram Company. A large portion of the property of the defendant is in Boston, and an attachment upon the same has been made.

The Shultz Belting Company, of St. Louis, have on exhibition at their New England offices samples of their new patent leather-woven link belt. The improvements claimed are that it is flexible laterally and lengthwise in all its parts, and is more pliable than a flat belt, or any other belt in the market. It weighs very little more than a double flat belt of the same width, and the form of the links and pliable rods cause it to adhere closely to the pulley, and, being so light, can be run wherever belts are used.

West End Notes.—The West End Street Railway have well under way a new power house on the site of the New England Gas Works, in Cambridge. The equipment of this plant will consist of ten 250 h. p. dynamos, furnishing power to about 250 electric cars. The power is now furnished by the Cambridge Electric Company, and will be until the new station is finished some time this fall. It is expected a large amount of new track will be laid this season. The old horse car rails on Tremont and Shawmut avenue, and on other lines, are found to be inadequate and a heavier rail, of the girder type, will be used. Tremont street and Washington street, from Boylston to Dudley, will also be equipped with the new rail. Orders have been placed with the Newburyport Car Company for six double truck Robinson Radial cars, and in a few months, about 35 additional electric, cars capable of holding 40 passengers, which are now being constructed, will be put on Windsor Locks, Conn. The new plant of this place will probably be completed by June 1. The Seymour Paper Company will light their whole works with electricity. The bridge owned by the N. Y., N. H. & H. R. R. Co. over the Connecticut River at this point will also be lighted by the new company.

Supervision of Electric Wires.—The mercantile committee has had a hearing upon several orders relative to the supervision of electric wires. E. W. Burdett appeared for the Massachusetts Electric Lighting Association, G. A. Bruce and S. L. Powers for the American Bell and New England Telepone companies, and F. A. Wyman for the Westinghouse Electric Company, Representative Means said that as the wires are run at present the rights and safety of the public are not properly guarded. Companies should be required to tag all wires at every fastening place on buildings, showing where the wires and for what purpose the wires are used, and each pole should be properly marked so that it will appear whether it carries a dead or a live wire. Theoretically towns and cities have the right to remove dead wires, but in Boston the City Council cannot pass the proper ordinances to render this right effective, and compulsory legislation is necessary. Mr. Means said he would make the companies responsible for the work under penalty. It might be necessary for the city to remove the existing dead wires at its own expense, but in future they should be removed by the companies. City Solicitor Bailey said that under the present law the city could not appropriate money for the removal of these wires. Mr. Burdett said the plan might very properly be amended to meet this defect.

Exhibition of Berrenberg Pump for Incandescent Lamp Globes.—A public exhibition of the Berrenberg vacuum pump was given at 109 Purchase Street, April 8, before several electric and scientific men. It is suitable for making the vacuum in the globes of incandescent lamps, or for any other work requiring a fine vacuum, and is invented and built by Adolph Berrenberg, of Somerville. Up to this time it has been considered by scientists impracticable to produce a vacuum sufficiently good for electric lamps by any other means than the glass mercurial pump. The pumps now in use are necessarily of small capacity, and the mercurial fumes render it unhealthy to work with them; in fact, the production of the vacuum is the most expensive and troublesome of the various processes necessary to complete the lamp. The Berrenberg pump is able to exhaust with ease more than a thousand at once, and in a very short time. It does alone what would require hundreds of mercurial pumps. It takes up very little room, and will not poison those who work it. The lamps made by it are better than others and will burn longer on account of the uniformly good vacuum itproduces. The pump has a strong syndicate interested in its development. The test showed that the machine is capable of doing what is claimed for it. Numerous experiments were made, all of which gave great satisfaction to those present.

L. H. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, April 12, 1890.

A New Motor.—Ex-County Commissioner Weaver, of Huntington, Pa., is bringing out a new electric motor.

The Milwaukee, Wis., Light and Power Company has been organized with a capital stock of $500,000.

Noyes Bros., Chicago, are sending out a neat catalogue of the the combination and electric fixtures of which they make a specialty.

The Kansas City, Kan., City Council have granted a franchise to T. J. Enright, the Argentine contractor, for an electric railway line.

Mr. J. E. Hall, Colchester, Ill., has placed an improved electric cigar lighter on the market that is said to be simple in action, neat and desirable.

The Westinghouse Electric Company, Pittsburgh, are installing a 50 arc light alternating current plant in one of the new towns in Tennessee.

The Tracy Printing Company, of Memphis, are now running their presses with the aid of a 3 h. p. Brush motor installed by the local lighting company.

Mr. Gilbert M. Smith, manager of the Chicago office of the American Brass and Copper Company, has returned from a trip to various Western points that has proven very successful.

The Heisler Electric Light Company, St. Louis, will probably establish a district office in Chicago within thirty days, and join the army of energetic young hustlers that make business by competing so closely for it.

An Extensive Purchase.—A syndicate having a capital of $5,000,000 is reported to have purchased the Birmingham Union Railway, the Ensley, Birmingham & Bessemer Motor line and the Birmingham Electric Light Co.'s plant.

The Central Electric Company, Chicago, report having on hand 1,000,000 feet of Okonite wire and 300 miles of Candee weather-proof wire. Surely the knowledge that such an amount is on hand ought to satisfy the most ambitious of contractors.

The Chicago City Fire Alarm Department is placing some 68,000 feet of No. 14 B. S. gauge, lead encased conductors, having Cobb vulcanized insulation, in the conduits along Jackson street, Mr. Geo. T. Davidson being in charge of the work.

The Elgin City Railway Company announces the purchase from the Edison company of its incandescent and arc lighting plants there, thus consolidating all electric enterprises. The company increases its capital to $200,000, and will have ten miles of electric railroad in operation June 1.

The Northwestern Electrical Supply and Construction Company, of Seattle, Wash., have just contracted to place the Partrick & Carter system of annunciators and fire alarm in the New Denny Hotel, of Seattle. The annunciator will have nearly 300 numbers, and will have return calls from each room to the office.

The Forest City Electric Works have been forced by increase of business into larger quarters, and have removed their factory from 183 Seneca street, Cleveland, to Geneva, Ohio. Mr. Cleveland is one of the youngest and at the same time one of the oldest electrical manufacturers in the business, and his success is well deserved.

The Electrical Supply Company, Chicago, having paid particular attention to the manufacture of pins and brackets, guarantee their product to be made of the best well seasoned hardwood, suitable for any condition, and have now on hand a stock sufficient to supply any demand. Their special split oak corner pins, 1½ inches, with bolt and washer, meet with ready sale, being just what is desirable on well-constructed lines.

Mr. Wilbur F. Callender, general agent for the Kirwin Electric Indicator Company of Scranton, Pa., is in the city introducing the Kirwin electric station indicator among the railroad fraternity. The device is inclosed in a handsome mahogany box about twenty inches long and eight inches high, and is operated by the current obtained from a Gassner dry battery that has been in almost constant use for many months, giving perfect satisfaction.

Mr. V. H. Smith, Secretary of the Seattle Electric Railway and Power Company, operatingthe Thomson-Houston system, was a visitor in the city last week. Mr. Smith referred to the financial success of his street car lines and to the fact that, though a cable system has paralleled his line, yet he has noticed no depreciation in the passenger traffic, but, on the contrary, many of the patrons have expressed their satisfaction at the absence of all shocks, jerks or vibrations in stopping or starting the cars. Mr. Smith is arranging for the introduction of several motors for light work in various factories.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 59@ $60
Central Union	58@ 59	Wisconsin	116@ 117
Michigan	96@ 98	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@$98	Chicago Edison Co	$113@$114

Incorporations.—The National Electric Light and Power Company, Arkansas City, Kan.; capital stock, $50,000. Directors, W. A. Thomas and J. F. Saunders, of Guthrie, Oklahoma, and M. F. Bailey, Charles Hutchins and E. L. McDowell, of Arkansas City, Kan.——Chicago and Evanston Rapid-Transit Company, to construct and operate a street railway; capital stock, $500,000; incorporators, R. J. Randolph, T. P. Bailey, J. M McSmith.——McClay Vestibule Car Company, at Chicago; to manufacture, purchase, sell and lease vestibule and other cars; capital stock, $1,000,000; incorporators, Fred. J. Hoyt John M. Clay and Leslie Malone. The Oregon Electric Light Co mpany, at Oregon, Ill., to furnish light, heat and power; capital stock, $5,000; incorporators, F. G. Jones, P. E. Hastings and J. C. Fesler.

The Pond Engineering Company will furnish and erect a complete steam plant for the Central Electric Company, Lexington, Ky., consisting of five 75 h. p. Armington & Sims engines, six 125 h. p. boilers, Lowe heater, Buffalo pumps, etc. Power will be furnished for an electric railway, and both arc and incandescent lamps. The Pond Engineering Company will furnish Armington & Sims engines to the Elgin (Ill.) street railway, and have just received the third order from the Laredo (Tex.) Improvement Company. They will furnish three 100 h. p. Armington & Sims engines (making five in all) to the Laredo Company, four boilers of 125 h. p. each, Lowe heator, duplicate boiler feed pumps, etc., including everything necessary to make the plant the most complete and best designed in the State of Texas. A very substantial power house will be erected, and a fine brick stack 100 feet high. The electric railway and city lighting plants will be driven from this station.

F. DE L.

SOUTHERN NOTES.

NORFOLK, Va., April 19.

A New Electric Road in the South.—A Northern syndicate has secured control of the electric interests in the towns of Winston and Salem in North Carolina, and an electric line connecting the two towns will soon be installed. The line will be five miles long, and will include six cars. The Sprague system of overhead wiring will be used. The dynamos will be located in the electric light station, which will hereafter supply both light and power for the street cars and general industries along the line.

This is probably the first station in the country from which will be distributed electric power for street railway and general industries, and light by both arc lamps and incandescent. Among the incorporators of the company mentioned, are E. H. Johnson, J. H. McClement, F. J. Sprague and E. B. Hawkes. Although electric roads are now in operation pretty generally throughout the Northern and Western States, the use of electricity as a method of propelling cars has not as yet met with such wide adoption among the cities of the Southern States. There are, it is true, a number of cities in the South where there are electric roads in operation, or in process of construction, but the horse and mule are still relied upon in most cities for the operation of the street cars. Northern capital, however, is rapidly developing many of the Southern towns, and a few years change a locality from a condition of inertness to one of business and enterprise. Salem-Winston is a good example of the progressive town of the new South, and shows by its enterprise in electrical enterprises that that it is fully awake to the latest and modern improvements.

Y. N. B.

THE ELECTRIC LIGHT.

Fort Collins, Colo.—The electric light company will spend $6,000 in extending its lighting system.

Cincinnati, O.—The Brush and Cincinnati electric light companies will hereafter use the same set of poles for their wires.

Rochester, N. Y.—A meeting of the stockholders of the Edison Electric Light Company will be held April 17, when a vote will be taken upon a proposition to increase the capital stock to $325,000.

The Brush Electric Light Company, of Baltimore, has increased its capital from $500,000 to $1,250,000, and, it is reported, that Mr. Westinghouse has practically secured control of the electric lighting business in that city.

The Westinghouse Electric Company has been awarded the contract for installing a new central station plant for electric lighting in Portsmouth, Va., with alternating current apparatus. The plant will start with a capacity of 1,500 lights.

Troy, N. Y.—The new arc light system of the Westinghouse Electric Company is to aid in dispelling the nightly darkness at Troy, N. Y., in the near future. The Westinghouse Electric Company has received an order from that place for a 60-light machine.

Asheville, N. C.—The city invites proposals for lighting by electricity for a period of two years from Oct. 1, 1890. Proposals to contemplate an option giving the city the right to purchase the plant at expiration of the period mentioned. Time for receiving bids is limited to May 1, 1890. The right is reserved to reject any or all bids, and to waive any defects.

Little Rock, Ark.—The stockholders of the Edison Electric Light and Power Company held their annual meeting on March 3 and relected the old board of directors. A very satisfactory year's business was reported. The board of directors elected the following officers: M. Q. Townsend, president: Nick Peay, treasurer and secretary, and A. S. Van De Mark, electrician and superintendant.

The Monongahela Mining Company is about to light one of its mines by electricity. The plant is to be of a special character so as to make it perfectly safe and economical. A current pressure of 300 volts will be utilized on the line, and the lamps will be placed in series of three throughout the mine. The arrangement in the shaft is such that three lamps can be distinguished at one time. The capacity of the plant is 150 lights and the Westinghouse Electric Company has the contract for furnishing the apparatus.

The Village at Saratoga Springe, Saratoga, N. Y., will be illuminated with electric lights during the coming season. The resort is to be furnished with a central station plant of 3,000 lights capacity. But beside that there will also be an arc light plant of 120 lights. Owing to the fact that the lights will have to be distributed over an extensive area, the machinery is to be of a special kind. A 2,000-volt pressure is to be used on the line. The plant will be furnished with the Westinghouse alternating current system. The new Westinghouse arc light system will be introduced here.

An important deal has just been pushed through in Cincinnati by which General Hickenlooper, President of the gas company, assumes control of all the electric light companies in the city. It was arranged by the Thomson-Houston Company, of Boston, to sell and deliver at once to Hickenlooper and others 1,010 shares of Brush Electric Company, and 304 of the Hauss Company and 300 shares of the Edison Company, and the new plant of the Cincinnati Electric Light and Power Company, recently built on Broadway. The consideration of transfer have not been made public, but it is estimated at $500,000. The directors of the Houston, Brush and Edison companies were asked to resign, and a new board consisting of representatives of the Hickenlooper interests was elected. The Cincinnati Electric Light and Power Company, which is owned by the Thomson-Houston Company, will go into liquidation, having arranged with the stockholders to return them all the money paid in, with interest. Although the Queen City Company is still outside of the combination, it is generally understood that it will fall into line at an early date.

APPLICATIONS OF POWER.

Washington, D. C.—A company is being formed to build an electric railway between Marlboro, Md., and Washington, D. C.

Passaic, N. J.—The electric street railway is progressing favorably under the direction of Mr. W. M. Freeman, and is expected to be completed on or about May 1st.

The Camden & Rockport Electric Light Company has recently installed an electric motor made by the Giant Motor Company, Portland, Me., for running a coffee mill.

Logansport, Ind.—Electric motors, sewing machines, etc., will be manufactured by the newly incorporated Pullman Electric Motor Company. The capital stock is $25,000.

Saanich, B. C.—At a public meeting a resolution was passed petitioning the Provincial Government to assist the National Electric Tramway Company of Victoria to build an extension to Saanich.

Gainesville, Tex.—The Gainesville Street Railway Co. will construct about 10 miles of extensions and re-equip its entire line. The company is also considering putting in an electric plant.

Vancouver, B. C.—The Vancouver Street Railway Company, and the Vancouver Electric Illuminating Company, will be incorporated as one company to carry on the business for which the two companies were formed.

Victoria, B. C.—The new electric street railway has been completed. Tests have been made and everything found to work well. It is said a uniform speed of 12 miles per hour will be maintained. Each car weighs six tons, and can comfortably carry from 26 to 35 passengers.

PERSONALS.

Henry W. Cooley, Boston, has secured a patent for a new style of regulators for dynamos.

Mr. Geo. W. Mansfield, Boston, Mass., has been granted a patent for an electric locomotive.

Mr. E. L. Clark, the Chicago representative of the Walworth Manufacturing Company, of Boston, was married on Thursday, the 10th inst., to Miss Lillian R. Shaw, at Bloomington, Ill.

Dr. A. F. Mason, of the Simplex Company, Boston, has started for a ten days' trip to Georgia, stopping at New York to attend the meeting of the Executive Committe of the National Electric Light Association. Doctor Mason is an exceedingly hard-worked man, but is always accessible and affable.

MISCELLANEOUS NOTES.

Chas. A. Schieren & Co. have sold to the Citizens' Electric Illuminating Company, of Brooklyn, 100 feet of 42-inch three-ply electric leather belting. They have previously sold 700 feet of double electric belting to the same company, besides all their dynamo belts, and have recently furnished the Municipal Electric Light Company with 300 feet for main driving belts and 325 feet of 8-inch double electric belting to run their dynamos.

The Wenstrom Southern Electric Manufacturing Company and Wenstrom Northern Electric Company have sold their entire plants, patents, etc., to the Wenstrom Consolidated Dynamo and Motor Company, of Baltimore, Md. The Consolidated Company was organized a short time ago, and chartered in Maryland. The officers are: E. L. Tunis, president; F. C. Latrobe, treasurer; William I. Rasire, secretary; and Dr. Joseph B. de Léry, general manager. Mr. de Léry is the organizer and promoter of all these Wenstrom companies, and is considered one of the most capable and successful managers of the present time.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company of Syracuse, N. Y., No. 105 South Warren street.

Warning to Investors.—Suit against the United States Aluminum Metal Company, of New York, operating the so-called Herault process of electric smelting, has been begun by the Cowles Electric Smelting & Aluminum Company, of Cleveland, O. The alleged process of Herault is a gross infringement of the Cowles patents, and investors are hereby warned that we shall maintain these claims to the full extent of the law.

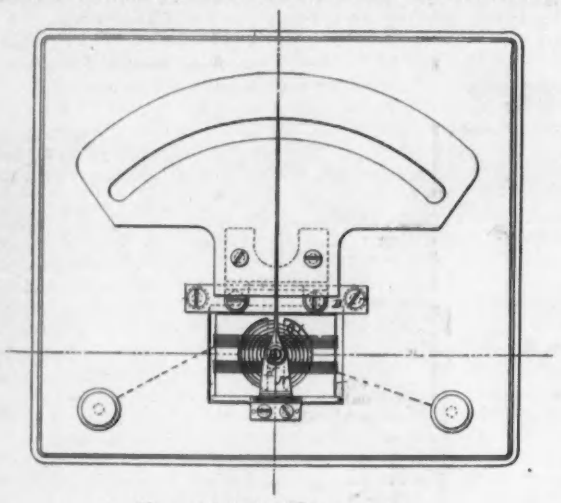
Eugene H. Cowles, President.

The Tropical American Telephone Company has an established record of the best kind for furnishing telephones and telephonic apparatus for export trade. Their business, ever large and excellent, has grown to such proportions that several important additions have recently been made to their executive force and facilities materially increased. Special attention is called to their corrected advertisement in this week's issue of this paper. Those who wish for the best instruments should send for their genuine "Bell" telephones and "Blake" transmitters, while those who consider price alone should order the cheaper European-made instruments at lowest prices.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED APRIL 8, 1890.

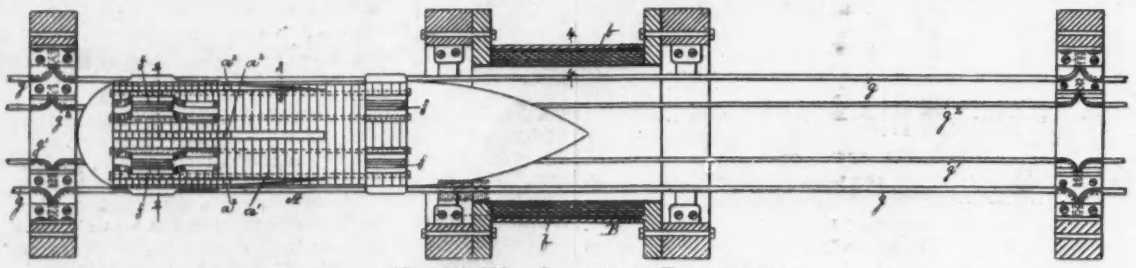
424,993. Telephone Toll-Box and Connection Register; Charles E. McCluer, of Richmond, Va. Application filed May 28, 1889. In combination with a Law system telephone call bell, an escutcheon and tube, a stationary contact piece in electrical connection with the call wire, and a movable armature supporting the contact piece in electrical connection with the sub-



No. 425,068.—Voltmeter.

scriber's wire, the two contacts so adjusted with relation to each other as to be capable of being electrically connected through openings in the tube by a metallic coin or token inserted in the tube, with an electro-magnet arranged to operate the movable contact piece.

424,995. Switch-Board; Edward A. Owen of East Saginaw, Mich. Application filed August 3, 1889. A switch board for electrical purposes, consisting of a series of parallel strips extending across a board or frame, a series of wires arranged in pairs, each pair constituting a strip and extending across the board above and at right angles to the other strips, and a connecting

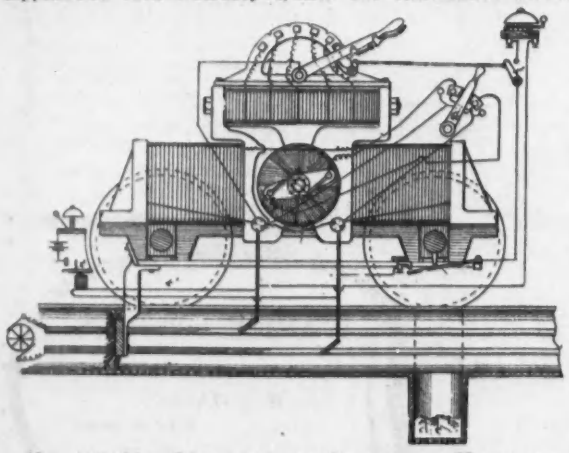


No. 425,038.—System of Telpherage.

pin adapted to form an electrical connection between the strips at their point of intersection.

425,038. System of Telpherage; James Eveleth Maynadier, of Taunton, Mass. Application filed August 10, 1889. In a system of telpherage a converter consisting of a number of main or exterior coils arranged end to end, each acting with the same interior coil, whether a single coil or a number of coils and whether the coils be connected with the source of power or one supplied with induced currents only, while the other is so connected.

425,058. Telephone Switch; Ernest P. Warner of Chicago Ill., Assignor to the Western Electric Company, of same place. Application filed February 1, 1888. The combination with the



No. 425,076.—Electrically Propelled Vehicle.

pivoted telephone hook or support having two lugs or bearing pieces provided upon the under side thereof, one of the bearing pieces being of insulating material and the other of metal, a spring secured at one end under the lever and having its free end extending backwardly under the bearings to permit the bearings to alternately rest upon different portions thereof as the lever is rocked or vibrated, whereby the electrical connection between the spring and lever is opened and closed alternately as the bearings are brought against different portions of the spring.

425,061. Lightning Arrester; James D. Bishop, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Feb. 3, 1890. A lightning arrester consisting of two insulated plates connected by a fusible wire, a curved metallic ground plate placed over the insulated plates and at a short distance therefrom to form an annular space between the insulated plates and the ground plate, whereby when an arc is formed the metal fused will be received in the annular space.

425,066. Balanced Pen for Autographic Telegraphs; Harry Etheridge, of Pittsburgh, Pa., Assignor to the Writing Telegraph Company, of New York, N. Y. Application filed Oct. 11, 1888. A fountain pen nib provided with a capilliary duct extending from end to end, pivoted on a suitable support, and having its writing point limb made slightly heavier than the other, whereby the limb may rest on the paper with a slight and uniform pressure.

425,068. Voltmeter; Madison M. Garver, of Newark, N. J., Application filed Dec. 14, 1889. The invention consists in the novel construction of the instrument, by means of which I am enabled to bring the coil in an intense magnetic field formed between the unlike poles of two magnets which are supported on a common axis passing through one side of the coil, and thus materially to increase the sensitiveness of the instrument.

425,076. Electrically Propelled Vehicle; Rudolph M. Hunter, of Philadelphia, Pa., Assignor by direct and mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed March 18, 1886. An electric railway motor having its field magnets formed of a series of coils, those on each magnet connected in series, in combination with an electric circuit supplying electricity to the magnets and switches to simultaneously put in or out of circuit any number of coils of each field magnet to vary the power or speed of the motor.

425,077. Electric Railway Car; Rudolph M. Hunter, of Philadelphia, Pa. Applicatian filed April 19, 1888. The combination of two axles and their wheels, with a motor frame extending from axle to axle, an electric motor supported thereon, having a longitudinal rotating shaft, gearing connecting the motor shaft with one of the axles, and a loose or giving connection between the said gearing and shaft, whereby the motor shaft may be free at all times and have provision for starting to rotate without material resistance.

425,078. Electrical Annunciator Drop; Martin Hynes, of Boston, Mass. Application filed Dec. 14, 1882. The invention consists of a shutter drop which falls when the annunciator circuit is closed. A pin on the shutter drop in falling comes in contact with a local battery spring which causes the bell to ring.

425,086. Central Office System for Autographic Telegraphs; James H. Robertson, of Rutherford, N. J., Assignor to the Writing Telegraph Company, of New York N. Y. Application filed August 30, 1886. The combination, with a number of conductors, terminating in a central or exchange office, of a battery, electro-magnet, and armature, and a pile of carbon discs, all arranged in the conductor for connecting the circuits, the armature being mounted to exert more or less pressure on the pile of discs as the strength of the current increases or decreases.

425,089. Thermostat; William F. Singer, of Carthage, Assignor of one-half to Gilbert L. Haviland, of Syracuse, N. Y. Application filed Dec. 19, 1889. In a thermostat the combination, with the case and an insulating bar of a metallic strip thereon, and having an opening for a post, a casting, secured to the case by fusible solder, the post secured at its lower end to the casting and provided at its upper end with a disc normally above the metallic strips, and electrical connections.

425,101. Support for Electric Railway Conductors; Conrad J. Killian, of Milwaukee, Wis., Assignor of one-half to Dustin Atwood, of same place. Application filed Dec. 21, 1889. In a support for overhead electric conductors, the combination of a pair of posts, an arched brace and a cross-wire or rod attached at the ends to the post and connected at the intermediate points, and a hanger by which the electric conductor is suspended thereon.

425,106. Electric Rotary Pump; Emory I. Nichols, of San Francisco, Cal., Assignor by Mesne Assignments to Irvine Stewart and Frank E. Tremper, of same place. Application filed March 13, 1889. A rotary pump comprising a fixed hollow shaft having an inlet and outlet port, the shaft having also an eccentric centre with an encircling port communicating with the inlet and outlet ports, a rim formed with the revoluble shell, and a wrapping of wire upon the rim to form of the shell an electric motor armature.

425,107. Device for Shielding and Protecting Wires; Herbert E. Penney, of Minneapolis, Minn., Assignor of one-half to Zachary T. Morrison of same place. Application filed Jan. 23, 1890. The invention consists of a hood or guard, preferably composed of flexible insulating material, for covering and protecting the trolley wire. This guard is trough or channel shaped in cross section, and is so mounted that its sides extend below the wire, and it protects the wire both from exposure to the elements and from all liability of engagement with loose or broken wires.

425,125. Electric Lighting and Advertising System; Arthur Douglass, of Danes Inn, Strand, County of Middlesex, England. Application filed Dec. 26, 1889. In an electric lighting system, the combination with a series of incandescent lamps and battery connections of a non-conducting ring, a series of internal contacts passed radially through the ring, each in circuit with one of the lamps, and a circuit closer adapted to make contact successively with the said contacts.

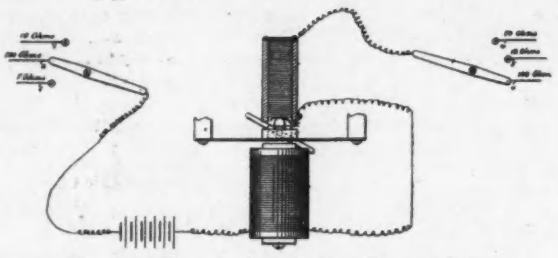
425,135. Electrode for Galvanic Batteries; William P. Kookogey, of Brooklyn, N. Y., Assignor to the Kookogey Chemical Light and Power Company. Application filed Dec. 11, 1889. The invention consists of a negative element made up of small wires or filaments electrically connected together, *i. e.*, the active surface of the element to be composed largely or wholly of wires, and such wires are to be of such small diameter that the bubbles of hydrogen will not remain attached to them, but will pass off.

425,143. Burglar Alarm; John Moran, of Adair, Mo. Application filed Dec. 5, 1889. In an annunciator, the combination with an electro-magnet and its armature, of a bell crank shaped lever having its lower branch terminating under and actuated by the armature and its upper end weighted, and a connecting bar arranged adjacent to the brush and adapted for contact with the same when the armature is attracted and the lever is actuated by the weight.

425,161. Telephone Toll-Box; Harry L. Cassard, of Baltimore, Md. Application filed October 19, 1889. A telephone toll-box having a pair of terminals adapted to be closed by a coin or its equivalent combined with and interposed in the extraneous portion of the circuit wire running from the telephone box to the receiver, the broken ends of which circuit wire are connnected to the coin closed terminals of the toll-box.

425,164. Method of Electric Welding; Charles L. Coffin of Detroit, Mich. Application filed November 6, 1889. The process of welding metals electrically, consisting in placing the articles to be welded in contact, connecting them with opposite poles of a generator of electricity, passing a heating current through them, simultaneously traversing the joint with an electric conductor, one end of which is connected with one pole of the generator and the other end in contact with the joint, and finally completing the weld by pressure.

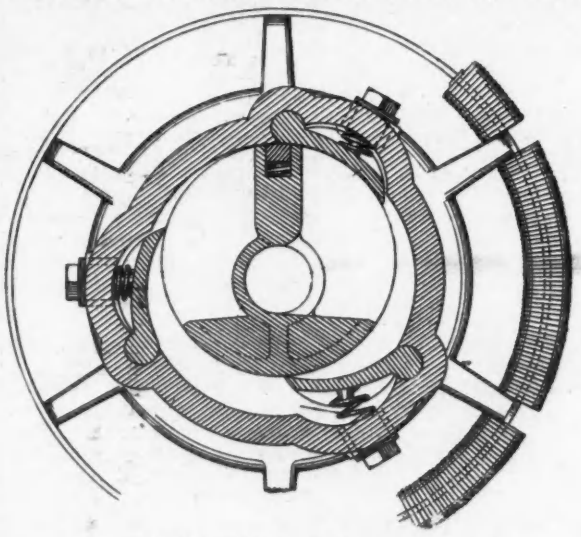
425,205. Switch; Arthur R. Bush, of Boston, Mass., Assignor to Paine & Francis, of same place. Application filed June 11, 1889. In a switch, the combination with a switch provided with projecting arms having contact pieces secured thereto and bent



No. 425,086.—Autographic Telegraphs.

to present inclined surfaces, of a co-operating contact strip or plate, a spindle extended through the base and to which the contact member is attached, a spring to move the spindle, a retaining rod, a spring to move the rod into engagement with the spindle, a yoke secured to the rod and having a finger piece, and an independent cap covering the yoke and rod, and having openings through which the spindle and finger piece are extended.

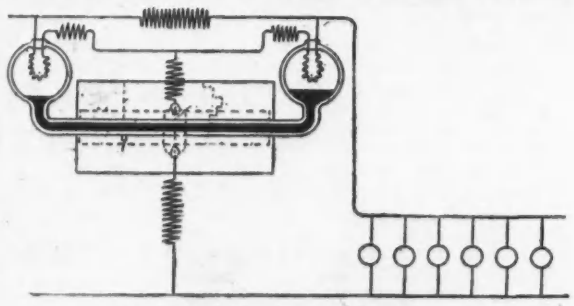
425,269. Electric Meter; Milton E. Thompson, of Boston, Mass. Application filed June 4, 1889. The invention consits sof an arrangement of coils, resistances and wires whereby a heat ing



No. 425,106.—Electric Rotary Pump.

effect is produced which shall be proportional to the electrical energy to be measured, and further of a thermopile, whereby a portion of the heating effect is converted into a continuous electric current, the continuous electric current being measured by means of an electrolytic cell.

425,270. Electric Meter; Milton E. Thompson, of Boston, Mass. Application filed Oct. 28, 1889. The invention consists of an arrangement of coils, resistances and wires, whereby a heating effect is produced proportional to the electrical energy to be measured, and further of an apparatus for measuring this heat-



No. 425,270.—Electric Meter.

ing effect, consisting of a differential thermometer dependent upon the expansion of a gas or liquid and producing an autographic record.

425,335. Process of Manufacturing Metallic Electrodes for Batteries; Frederic Marx, of Berlin, Germany. Application filed Dec. 30, 1889. The process of manufacturing metallic electroides for galvanic batteries by purifying from the presence of salts the metallic deposit obtained by the electrolytic process or by precipitation with other metals and then rolling into the mass so purified a wire-woven fabric or metal plate.

425,388. Electric Railway Apparatus; John B. Odell, of Chicago, Ill., Assignor of one-half to Horatio N. May, of same place. Application filed Nov. 30, 1889. An electric railway system comprising main conductors arranged in series of insulated sections, branch conductors uniting the end of both conductors of a section to the same conductor of the adjacent section, a switch mechanism consisting of an electric magnet and suitable contact points to break the flow of current through one of the branch conductors and establish the flow of current through the other of branch conductors and a resistance coil or medium interposed in one of the branch conductors.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give date and number, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.